Technical Series No. 7.

Insects

U. S. DEPARTMENT OF AGRICULTURE.

DIVISION OF ENTOMOLOGY.

REVISION OF THE TACHINIDÆ

OF

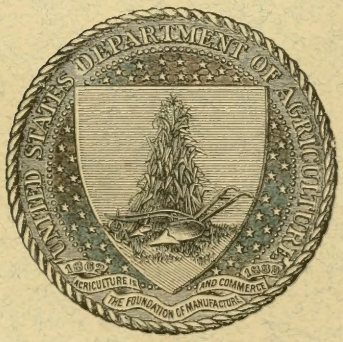
AMERICA NORTH OF MEXICO.

A

FAMILY OF PARASITIC TWO-WINGED INSECTS.

BY

D. W. COQUILLETT.



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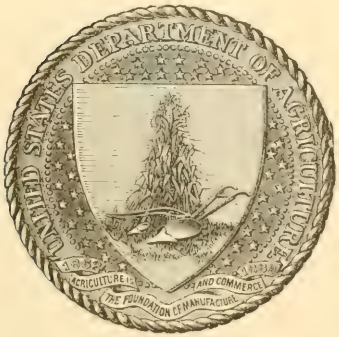

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LETTER OF TRANSMITTAL.

UNITED STATES DEPARTMENT OF AGRICULTURE,
DIVISION OF ENTOMOLOGY,
Washington, D. C., June 2, 1897.

SIR: I have the honor to submit for publication the seventh of the technical series of bulletins of this Division. It has been prepared by Mr. D. W. Coquillett, of the office force, and consists of a revision of the species of the parasitic flies belonging to the family Tachinidæ, which occur in the United States and Canada. The desirability of such a revision of these economically important flies has been apparent to all workers in economic as well as systematic entomology for many years. They are among the most important enemies of many of our most injurious insects, and their characters are so obscure that workers have had the greatest difficulty in separating one species from another, and the result is that the literature of economic entomology in particular contains many wrong determinations and absolute misstatements based upon such erroneous names. During the last eighteen years many species of Tachinidæ have been reared at this office from injurious insects which were being studied. It has been heretofore impossible to record the results of these rearings, on account of the confusion which existed in this family, and in its original conception this study of the group was undertaken in order to enable us to record the results of this biologic work. The records are now given in the shape of two tables—one of parasites and hosts and the other of hosts and parasites—and a glance at these tables will be instantly convincing as to the important and beneficial rôle which these insects play. With the clear and systematic diagnoses of the genera and species which Mr. Coquillett has prepared, any economic entomologist should be able to determine just what species of Tachina flies are assisting him in his work against injurious insects.

Respectfully,

L. O. HOWARD,
Entomologist.

Hon. JAMES WILSON,
Secretary of Agriculture.

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REVISION OF THE TACHINIDÆ OF AMERICA NORTH OF MEXICO.

NATURE AND SCOPE OF THE WORK.

The present paper is the result of several years' study, and is based upon the large series of specimens contained in the National Museum collection, mainly received from this office, supplemented by those in my own and those received for study and identification from various correspondents, among whom may be mentioned: Mr. C. W. Johnson, Dr. Garry deN. Hough, Mrs. A. T. Slosson, Dr. W. A. Nason, Mr. Charles Robertson, Mr. Theodore Pergande, Mr. F. H. Chittenden, Prof. H. E. Weed, Mr. R. W. Doane, and L'Abbé Bégin. The series in the National Museum collection is especially valuable, containing as it does a large number of bred specimens, which, more than anything else, enables us to correctly judge of the extent to which the various specimens of the same species will vary among themselves. This collection also contains a duplicate set of a series of specimens sent to Brauer and Bergenstamm, of Vienna, Austria, in exchange for a named series of European forms, and the latter have been very valuable for comparison with our own genera and species. These authors returned names, principally generic, of the series sent to them, and in the following pages I have indicated these identifications as "*in litt.*" Mr. C. H. T. Townsend kindly sent to the Museum cotypes of many of his new species, and Mr. Charles Robertson generously donated specimens from the same series as those from which Mr. Townsend described several of his new forms.

The region covered by this paper includes all of this country north of Mexico, but does not take in any of the West Indies. When the faunas of these two regions have been carefully compared with our own, many additional species will no doubt be found to inhabit two or even all of these regions.

HABITS OF THE FAMILY.

Among the fifty odd families into which the Diptera of this country have been divided, the Tachinidæ is by far the most beneficial, judged from the standpoint of an agriculturist. The only other family that at all competes with it for this honor is the Syrphidæ; but in this family

only a comparatively small number of genera are directly beneficial by preying upon plant-lice, and even in this respect their services could in most instances be dispensed with, since, as a general rule, the plant-lice are held in check by the larvæ of ladybirds assisted by several kinds of internal parasites belonging to the hymenopterous families Braconidæ, Cynipidæ, and Chalcididæ.

So far as at present known the Tachinidæ prey upon living insects only, and by far the greater number of these are the leaf-eating caterpillars of butterflies and moths, a group that contains a large number of our most injurious insects; and the numbers of these destroyed in a single season by these parasites is almost beyond computation. Unlike the parasitic Hymenoptera, each species of which as a rule confines its attacks to a single group which in some cases is restricted to one genus, it not infrequently happens that the same species of Tachina fly attacks several different families of insects, while quite a number are known to attack two and even three different orders of insects—Lepidoptera, Hymenoptera, and Coleoptera. This has been observed not only in our own country but also in Europe.

At present, only five different orders of insects—the three above mentioned and the Orthoptera and Hemiptera—are known to be attacked by the Tachinidæ in this country, but in Europe several cases are reported of their also attacking Diptera of the family Tipulidæ. The Lepidoptera, Hymenoptera, and Diptera are preyed upon in their preparatory stages only, whereas it is usually only the adults of the Orthoptera, Hemiptera, and Coleoptera that are attacked.

The tachinid eggs are attached by a viscid substance to the surface of the host, and the full-grown larvæ usually enter the earth to pass through their transformations. The larvæ are of the usual maggot form, large and truncated at one end and tapering to a point in the opposite direction. Pupation takes place in the hardened skin of the larva, which assumes a nearly cylindrical form with rounded ends, and is known as a puparium. In issuing, the adult fly breaks away the entire end of the puparium. It was formerly supposed that any caterpillar upon which one of these flies had fastened an egg was doomed to certain destruction, but actual observation has shown that this is not always the case, since in many instances the caterpillar, by molting or casting off its skin, rids itself of the egg before the latter has hatched out and the young larva made its way into the body of the caterpillar. In this respect the parasitism of these insects is not so certain as is the case with those hymenopterous parasites which puncture the body of their victim and deposit the egg within.

In regard to the possession and exercising of that faculty commonly termed instinct, the Tachina flies appear to be far behind the parasitic Hymenoptera. The latter seem to be able to ascertain by a touch of their antennæ whether or not an insect has already been parasitized, and only rarely insert an egg in the body of an insect that already

contains an egg or larva of a parasite, nor has one of them been known to consign a greater number of eggs to an insect than the number of larvæ which that insect can maintain. On the contrary, a Tachina fly has repeatedly been known to attach to a caterpillar three or four times as many eggs as the number of larvæ the caterpillar can maintain. Owing to this fact, a great many tachinid larvæ must necessarily perish for want of food, while several which have barely had a sufficient quantity to keep them alive will be considerably dwarfed in size, as compared to their more fortunate brothers, and thus it will sometimes happen that some of the adult flies will be only one-half, and in rare instances even only one-third, as long as others which were the progeny of the same parent. Certain systematic writers, who have had no experience in rearing these flies, lay great stress on a difference in size as indicative of a distinct species; but our breeding records have abundantly demonstrated the fact that one specimen may be fully three times as long as an other and yet both belong to one and the same species.

TACHINID FLIES AND THEIR HOSTS.

The following is a list of the Tachina flies that have been bred by this Division, together with the hosts from which they were bred. By far the greater number of these were reared in the department insectary, in charge of Mr. Theo. Pergande. A few additional species, specimens of which have been studied by the writer, are included in this list. Of the published records, only those are included where the flies have been bred from other hosts than those from which this Division and its correspondents have reared them; such species are indicated by asterisks (*) in addition to the names of the persons who reared them and to the published references. A few of the breeding records, which are evidently erroneous, are preceded by a mark of interrogation (?).

The list is in two parts, arranged alphabetically:

I.—Parasites and their hosts.

Parasites.	*Host insects.*
Acemyia dentata *Coq*	Chortophaga viridifasciata *DeG.* Bred by T. Pergande June 26, 1877, from an adult collected June 11 at St. Louis, Mo.
Admontia demylus *Walk*	Lophyrus abbotii *Leach.* Issued June 24, 1882, from a larva collected by E. A. Schwarz, in Maryland.
	Lophyrus lecontei *Fitch.* Issued May 6, 1886, from a larva collected by T. Pergande in Virginia, October 19, 1885.
Admontia retiniæ *Coq*	Retinia sp. Bred April 17, 1888, by A. Koebele, Alameda, Cal., from a caterpillar found in a bud on *Pinus insignis.*
Amobia distincta *Town*	Acronycta dactylina *Grote.* Issued March 24, 1884, from a caterpillar collected by A. Koebele at Holderness, N. H., September 26, 1883.

Aphria ocypterata *Town* .....Carneades messoria *Harr.* Bred by C. V. Piper, Pullman, Wash.

Archytas analis *Fabr* .....*Clisiocampa californica *Stretch.* (Gillette, Trans. Amer. Ent. Soc., Vol. XXII, p. 70.)

Archytas aterrima *Desv*.....Acronycta occidentalis *G. & R.* Issued August 13, 1883, from a chrysalis collected July 10 by A. Koebele in Virginia.

Acronycta ovata *Grote.* Issued May 13, 1886, from a caterpillar received from J. G. Barlow, Cadet, Mo.

Cerura sp. Bred by O. Lugger April 11, 1874, from a caterpillar received from G. W. Letterman, October 12, 1873.

Lagoa crispata *Pack.* Issued June 5, 1885, from a cocoon received October 22, 1884, from J. M. Shaffer, Keokuk, Iowa. Another issued February 15, 1890, from a cocoon collected in Washington, D. C., in September, 1889.

Belvosia bifasciata *Fabr*.....Citheronia regalis *Fabr.* Issued July 17, 1873, and June 24, 1881.

Dryocampa rubicunda *Fabr.* Bred August 15, 1872, by O. Lugger, at St. Louis, Mo., from a caterpillar collected July 3.

Hemileuca sp. Bred in 1889 by A. Koebele, from a caterpillar found at Lancaster, Cal.

Belvosia unifasciata *Desv*.....Leucania unipuncta *Harr.* Bred in 1896 by M. V. Slingerland, at Ithaca, N. Y.

Biomyia georgiæ *Br. & Berg*....Calosoma calidum *Fabr.* Bred by A. F. Burgess June 28, 1896, from a beetle found June 6 at Amherst, Mass.

Calosoma peregrinator *Guér.* Bred by the writer June 25, 1888, at Los Angeles, Cal.; the tachinid puparia were found in a dead beetle June 17.

Blepharipeza adusta *Loew* .....Arachnis picta *Pack.*

Clisiocampa constricta *Stretch.* Bred in January and February, 1891, by A. Koebele from caterpillars collected at St. Helena, Cal.

Clisiocampa thoracica *Stretch.* Bred in 1890, by A. Koebele, from caterpillars collected at Glen Ellen, Cal.

Halisidota edwardsii *Pack.* Bred by the writer at Los Angeles, Cal.

Leucarctia acræa *Drury.* (H. Edwards, in Loew's Dipt. Amer. sept. indig., Cent. X, No. 67.)

Brachycoma davidsoni *Coq*.....Bombus fervidus *Fabr.* Bred by Dr. A. Davidson, Los Angeles, Cal.; the tachinid larvæ fed on those of the Bombus.

Celatoria diabroticæ *Shimer*....Diabrotica 12-punctata *Oliv.* Issued August 3, 1889, from adult beetles collected by T. Pergande in Washington, D. C.

Diabrotica soror *Lec.* Bred by the writer July 5, 1888, at Los Angeles, Cal.; the tachinid larva issued from an adult beetle June 21. Another issued August 15 and was changed to a fly August 28. Other flies issued August 29 and 31. Also bred in June, 1889, by A. Koebele from an adult collected in Santa Clara County, Cal.

Celatoria diabroticæ *Shimer*.....Diabrotica vittata *Fab.* Bred July 21 and August 5, 1897, by F. H. Chittenden from an adult collected at Brookland, Md.

Chætogædia crebra *r. d. W*.....Agrotis sp. Bred July 11, 1888, by the writer from a caterpillar found June 2 at Los Angeles, Cal.

Taeniocampa rufula *Grote.* Bred July 29, 1888, by the writer from a caterpillar found June 9 at Los Angeles, Cal.

Chætogædia monticola *Bigot*....Carneades sp. Bred by W. G. Wait, Kailua, N. Kona, Hawaii.

Peridroma saucia *Hueb.* Issued June 14, 1895, from a chrysalis received May 13 from William Chappelow, Monrovia, Cal.

Pyrameis cardui *Linn.* Bred by the writer at Los Angeles, Cal.

Cistogaster immaculata *Macq*...(?)Leucania unipuncta *Haw.* (Forbes, Psyche, June, 1893, p. 466.)

Cryptomeigenia theutis *Walk*...Lachnosterna inversa *Horn.* Issued March 23, 1893, from an adult beetle collected by T. Pergande, in May, 1892, at Washington, D. C.

Echinomyia algens *Wied*.....Hadena lignicolor *Guen.* (Gillette, Trans. Amer. Ent. Soc., Vol. XXII, p. 70.)

Epigrimyia floridensis *Town*....Plodia sp. Bred by T. D. A. Cockerell, Mesilla, N. Mex.

Euphorocera claripennis *Macq*..Acronycta hamamelis *Guen.* Issued August 8, 1882, from a caterpillar collected July 23, by A. Koebele, in Virginia.

Agraulis vanillæ *Linn.* Bred September 12, 1893, by Dr. A. Davidson, Los Angeles, Cal.

Aletia argillacea *Hueb.* Issued August 11, 1879.

Anisota senatoria *S. & A.* Issued June 13, 1880.

*Apatura celtis *Bd.-Lec.* (Riley, in Scudder's Butterflies of New England, Vol. III, p. 1922.)

Apatura clyton *Bd.-Lec.* Bred by H. A. Morgan, Baton Rouge, La.

Arctia docta *Walk.* Bred June 26, 1883, by the writer at Anaheim, Cal.

Ceratomia catalpæ *Boisd.* Issued January 7 and October 5, 1894, and January 5 and 26 and February 20, 1895.

Chrysomela multipunctata *Say.* Bred July 14, 1872, by O. Lugger from a larva found July 1 at St. Louis, Mo.

Clisiocampa disstria *Hueb.* Bred by C. H. Fernald, Amherst, Mass

Crocota rubicundaria *Hueb.* Issued October 25, 1882, from a caterpillar collected March 15 by A. Koebele at Archer, Fla.

Datana contracta *Walk.* Bred August 30, 1886, by F. M. Webster, Lafayette, Ind.; one caterpillar bore 115, another 131, a third 213, and a fourth 228 eggs of the Tachina fly.

Empretia stimulea *Clem.* Issued July 24, 1885, from a cocoon received September 3, 1884, from J. B. Smith, Monticello, Ind.

Euphorocera claripennis *Macq.*..Epilachna borealis *Fabr.* Bred by Dr. Riley, September 10, 1871, from a larva collected August 18 in New York or New Jersey.

Eubolina? sp. Bred by A. Koebele from a caterpillar found on *Prosopis juliflora* in Panamint Valley, California, in 1891.

Feltia herilis *Grote.* Issued May 11, 13, and 18, 1895, from caterpillars received April 13 from W. D. Kierolf, Jackson, Tenn. Also June 6, 1895, from a caterpillar received May 8 from S. Merrill, Mine la Motte, Mo.

Halisidota tessellata *S. & A.* Issued August 24, 1896, from a caterpillar received August 1 from L. Collins, Brooklyn, N. Y.

Harrisina americana *Harris.* Issued June 26 and 27, 1891, from a caterpillar received June 13 from J. F. Wilson, Poulan, Ga.

Hemileuca artemis *Pack.* Issued April 30, 1894, from a caterpillar received June 6, 1893, from T. D. A. Cockerell, Las Cruces, N. Mex.

Hemileuca electra *Wright.* Bred June 25, 1887, by the writer from a caterpillar collected April 12 near Riverside, Cal.; the tachinid larva issued June 5.

Lagoa sp. Issued October 3, 1878.

Lophyrus sp. Issued March 5, 1889, from a larva received September 28, 1888, from G. W. Martin, Chattanooga, Tenn.

Mamestra trifolii *Rott.* Bred July 4, 1876, by T. Pergande from a caterpillar received June 8 from M. G. Gant, Parksville, Mo. Issued November 17 and 18, 1881, from a caterpillar collected October 12 by Dr. Howard in Washington, D. C.

Œdemasia concinna *S. & A.* Bred August 23, 1876, by T. Pergande from a caterpillar received August 16 from John Barritt, East Canton, Mo.

Orgyia leucostigma *S. & A.* Issued September 21, 1895, from a chrysalis collected September 6; and September 23 from a chrysalis collected September 6; and September 24 from caterpillars collected September 4, 7, and 11; and September 30 from a caterpillar collected September 11, 1895. Also issued April 16 and in July, 1896. All were from Orgyias collected at Washington, D. C.

Phasiana neptata *Guen.* Bred July 2, 1886, by the writer at Los Angeles, Cal.; the tachinid larva issued June 2.

*Vanessa antiopa *Linn.* (Dimmock, in Scudder's Butterflies of New England, Vol. III, p. 1922.)

Eutrixa masuria *Walk.*.....Lachnosterna arcuata *Smith.* Issued March 12, 16, and 23, 1895, from an adult beetle collected in Washington, D. C.

Exorista affinis *Fall* .....Arctia? sp. Issued December 16, 18, and 19, 1889, from a caterpillar stated to be European, received December 2 from O. Lugger, St. Anthony Park, Minn.

Exorista blanda *O. S.*.....Euclea cippus *Cram.* Issued June 24, 1884, from a caterpillar collected October 9, 1883, by A. Koebele, in Virginia.

*Nisoniades brizo *Bd.-Lec.* (Scudder, Butterflies of New England, Vol. III, p. 1919.)

*Pyrameis cardui *Linn.* (Riley, Canadian Entomologist, Vol. XIX, p. 163.)

Exorista boarmiæ *Coq*.....Boarmia pampinaria *Guen.* Issued September 12, 1883, from a caterpillar received August 13 from J. B. Smith, Cotuid, Mass.

Loxostege similalis *Guen.* Issued July 16, 1886, from a chrysalis received from W. F. Avera, Camden, Ark.

Exorista ceratomiæ *Coq*.....Ceratomia undulosa *Walk.* Bred May 28, 1875, by Dr. Riley, from a caterpillar found October 2, 1874, at St. Louis, Mo.

Omphalocera cariosa *Led.* Issued July 2, 1892, from a caterpillar received from W. S. Newlon, Oswego, Kans.

Pempelia sp. Issued May 28, 1889, from a caterpillar found by H. Allison on a hackberry tree in October, 1888, at Fort Worth, Tex.

Pyralid. Issued in September, 1890, from a caterpillar found on poison ivy by J. G. Barlow, Cadet, Mo.

Exorista cheloniæ *Rond.*.....Arachnis picta *Pack.* Bred in 1882 by the writer at Anaheim, Cal.

Arctia docta *Walk.* Bred June 26, 1883, by the writer at Anaheim, Cal.; the tachinid larva issued June 17.

Exorista confinis *Fall.*.....*Chrysophanus xanthoides *Boisd.* (Skinner, Entomological News, December, 1891, p. 198.)

Dendrobinus howardi *Dyar.* Issued April 20, 1895, from a caterpillar received April 10 from J. W. Toumey, Tucson, Ariz.

Lycæna exilis *Boisd.* Bred by T. D. A. Cockerell, Las Cruces, N. Mex.

*Lycæna pseudargiolus *Bd.-Lec.* (Scudder, Butterflies of New England, Vol. III, p. 1920.)

Lycæna sp. Issued May 24, 1886, from a caterpillar found on a hickory tree May 9, by T. Pergande, in the District of Columbia.

*Thecla calanus *Hueb.* (Saunders, Can. Entomologist, Vol. XIX, p. 166.)

Exorista eudryæ *Town.*.....Acronycta hamamelis *Guen.* Issued August 8, 1882, from a caterpillar found by A. Koebele, July 23, in Virginia.

Acronycta luteicoma *G. & R.* Bred by Dr. Riley December 31, 1871, at St. Louis, Mo.

Acronycta sp. Bred April 11, 1874, by O. Lugger, from a caterpillar collected April 5, 1873, at St. Louis, Mo. Issued July 24, 1882, from a caterpillar found by A. Koebele, July 9, on an oak tree at Hyattsville, Md. Another issued May 10, 1883, from a caterpillar found on an oak tree.

Agrotis ypsilon *Rott.* Issued February 15, 1875.

Exorista eudryæ *Town*.....Alypia octomaculata *Hueb.* Issued June 2, 1884, from a caterpillar received from Missouri.

Eudryas unio *Hueb.* Bred by H. S. Jewett, Dayton, Ohio.

Heterocampa marthesia *Cram.* Bred by O. Lugger, at St. Louis, Mo.

Hyperchiria io *Fab.* Issued May 31, 1895.

Pyrameis atalanta *Linn.* Bred by P. S. Sprague, Boston, Mass.

Exorista flavirostris *v. d. W.*....Lagoa opercularis *S. & A.* Issued June 30, 1880, from a cocoon received March 4, from R. S. Turner, Fort George, Fla. Also January 21 and 22, 1889, from a caterpillar received from T. M. McMeekin, McMeekin, Fla. Also December 3 and 4, 1889, from a caterpillar received from Dr. Neal, Florida; and July 31, 1893, from a cocoon received from E. W. Rogers, Jennings, Va. Bred May 11, 1891, by H. E. Weed, Agricultural College, Mississippi. Issued June 2, 1896, from caterpillars collected November 25, 1895, by E. A. Schwarz, at Victoria, Tex.

Exorista futilis *O. S.*.....Clisiocampa thoracica *Stretch.* Bred in 1890, by A. Koebele, at Glen Ellen, Cal.

Hadena apamiformis *Grote.* Issued May 16, 1884.

*Pyrameis atalanta *Linn.* (Harris and Scudder, Can. Entomologist, Vol. XIX, p. 162.)

Exorista griseomicans *v. d. W.*..Orgyia leucostigma *Sm. & Abb.* Issued July 17, 1896, from a cocoon collected in Washington, D. C.

Exorista isæ *Coq.*.....Isa inornata *G. & R.* Issued June 16, 1886, from a caterpillar collected September 29, 1885, by O. Lugger.

Exorista lobeliæ *Coq*.....Acronycta hamamelis *Guen.* Issued August 8, 1882, from a caterpillar collected by A. Koebele in Virginia.

Acronycta lobeliæ *Guen.* Issued April 21, 1885.

Acronycta sp. Issued July 28 and 31, 1882, from a caterpillar found on an oak tree in Maryland, July 2, by A. Koebele.

Orgyia leucostigma *S. & A.* Issued July 21, 1897, from a cocoon collected in Washington, D. C.

Exorista petiolata *Coq*.....Lophyrus sp. Issued June 23, 1883, from a larva collected June 3, by Dr. Riley, in Virginia.

Exorista pyste *Walk*.....Hyponomeuta multipunctella *Clem.* Issued June 20 and 23, 1884, from a caterpillar collected June 1, by A. Koebele, in Washington, D. C.

Mineola indiginella *Zell.* Issued July 9, 1886, from a caterpillar received from O. S. Roberts, Oxford, Ind. And June 18, 1897, from a caterpillar received June 10, from W. A. Fisher, Moselle, Mo.

Pyralid. Issued June 22, 1886, from a caterpillar found May 9, on a hickory tree, by T. Pergande, at Washington, D. C. Also October 6, 1896, from a caterpillar found August 10, on cabbage, by H. M. Simons, Charleston, S. C.

*Thecla autolycus *Edw.* (Belfrage, in Scudder's Butterflies of New England, Vol. III, p. 1921.)

Exorista pyste *Walk*.....Tortricid. Issued June 26, 1889, from a caterpillar found June 21, on a cedar tree by H. T. Fuchs, Tiger Mills, Tex.

Exorista vulgaris *Fall*.....* Pieris rapæ *Linn.* (Lintner, Can. Entomologist, Vol. XIX, p. 164.)

* Pyrausta penitalis *Grote.* (Forbes, Pysche, June, 1893, p. 467.)

Frontina aletiæ *Riley*.....Aletia argillacea *Hueb.* Issued November 23, 1878. Also bred August 21 to 31, 1880, by H. G. Hubbard, at Centerville, Fla.

Cerura sp. Bred by A. Koebele from a caterpillar found on willow at Los Angeles, Cal.

Dasylopha anguina *S. & A.* Bred by E. Burgess, Beverly, Mass.

Halisidota maculata *Harr.* Bred in February, March, and April, 1889, by the writer at Los Angeles, Cal.

Halisidota tessellata *S. & A.* Issued August 14 and 15, 1896, from a caterpillar received from L. Collins, Brooklyn, N. Y.

Lagoa opercularis *S. & A.* Issued November 27, 1891, from a caterpillar received November 12 from H. Stevens, Brazaria, Tex.

Orgyia leucostigma *S. & A.* Issued September 18, 1895, from a caterpillar collected September 7; and September 20 from a caterpillar collected September 5, the tachinid larva having issued September 9. Also September 23 from a cocoon collected September 6. Also September 30 from a caterpillar collected September 13; the tachinid larva issued September 18, 1895. Also issued in January, February, and July, 1896. All were from Orgyia collected at Washington, D. C.

Frontina archippivora *Will*.....Agrotis ypsilon *Rott.*

Clisiocampa constricta *Stretch.* Bred by Dr. A. Davidson, Los Angeles, Cal.

Clisiocampa pluvialis *Dyar.* Bred by C. V. Piper, Pullman, Wash.

Danais archippus *Fabr.* Bred by C. W. Johnson, Philadelphia, Pa.; and C. V. Piper, Pullman, Wash.

Laphygma flavimaculata *Harv.* Issued May 29, 1897, from a caterpillar received May 17 from S. A. Pease, San Bernardino, Cal.

Pyrameis cardui *Linn.* Bred by the writer at Los Angeles, Cal.

Pyrameis carye *Hueb.* Bred February 20, 1888, by A. Koebele, Alameda, Cal.; also bred by the writer at Los Angeles, Cal.

Frontina armigera *Coq*.....Heliothis armiger *Hueb.* Bred June 14, 1888, by the writer at Los Angeles, Cal.; the tachinid larva issued June 1.

Frontina frenchii *Will*.....Anisota senatoria *S. & A.* Issued in August, 1879, and June 21, 1880. Also July 7, 16, 18, and 22, 1896, from caterpillars collected by F. C. Pratt at Lakeland, Md., September 2, 1895.

Frontina frenchii *Will*.....Anisota virginiensis *Drury*. Issued May 27 and June 7, 1874.

Attacus cecropia *Linn.* Bred March 17, 1890, by G. Valentine, Haramontown, N. J.

Attacus sp. Bred June 21, 1891, by the writer, from a Cecropia-like cocoon on *Ceanothus* sp., near Los Angeles, Cal.; the tachinid larva issued May 26.

Bombus sp. Bred from a nest; Canada.

Ceratomia catalpæ *Boisd.* Issued in August, 1890, from a caterpillar collected in the District of Columbia.

Citheronia regalis *Fabr.*

Clisiocampa americana *Harr.* Issued July 17, 1893, from a cocoon received July 14 from G. B. King, Lawrence, Mass.

Clisiocampa californica *Stretch.* Bred in May, by A. Koebele, Alameda, Cal.

Clisiocampa constricta *Stretch.* Bred July 5, 1889, by the writer, from a caterpillar collected May 5 near Los Angeles, Cal.

*Clisiocampa disstria *Hueb.* (Harvey, Psyche, May, 1891, p. 85.)

Clisiocampa thoracica *Stretch.* Bred in 1890 by A. Koebele from a caterpillar found at Glen Ellen, Cal.

Dasylopha anguina *S. & A.* Bred by E. Burgess, Beverly, Mass.

Datana ministra *Drury.* Issued May 2, 21, 25, and 30, 1874. Also September 11, 1893, and July 17 and August 6, 1894, from caterpillars received July 21, 1893, from A. W. Butler, Brookville, Ind.

Datana sp. Issued May 28, 1875, from a caterpillar found on a birch tree.

Dissosteira carolina *Linn.* Three were bred April 22, 1874, by O. Lugger, from adults collected at St. Louis, Mo., the previous year.

Dryocampa rubicunda *Fabr.* Issued June 30, 1896, from a caterpillar collected by F. C. Pratt, July 11, 1895, at Lakeland, Md.

*Euchaetes egle *Drury.* (Forbes, Psyche, June, 1893, p. 467.)

Heliothis armiger *Hueb.*

Hyperchiria io *Fabr.* Bred October 11, 1879, by G. H. French, Carbondale, Ill.

Hypsoropha hormos *Hueb.* Issued July 18 and 23, 1884.

Ichthyura inclusa *Hueb.* Bred March 11, 1875, by O. Lugger, from a caterpillar collected at St. Louis, Mo., the previous year. Also bred in 1889 by F. M. Webster, Lafayette, Ind. Issued July 27, 1893, from a cocoon received July 18.

Orgyia leucostigma *S. & A.* Issued in July, 1896, from caterpillars collected at Washington, D. C.

*Papilio turnus *Linn.* (Scudder, Butterflies of New England, Vol. III, p. 1923.)

Frontina frenchii *Will*.....Pyralid. Issued April 28 and May 8, 1883, from caterpillars found October 20, 1882, on an alder tree in Virginia by A. Koebele.

Pyrameis cardui *Linn.* Bred by F. M. Webster; Townsend *in litt.*

Schizura unicornis *S. & A.* (F. A. Marlatt, Psyche, December, 1891, p. 187.)

Smerinthus cerisyi *Kirby.* Bred by A. Koebele, in 1887, from a caterpillar found at St. Helena, Cal.

Telea polyphemus *Cram.* Issued November 15, 1882, and May 3, 1884. Also bred by S. Baldy, Catawissa, Pa.

Frontina irrequieta *Walk*.....Papilio thoas *Linn.* Issued February 23, 1880, from a chrysalis received January 27 from Prof. J. H. Comstock, Jacksonville, Fla.

Frontina violenta *Walk*.....Philampelus vitis *Linn.* Bred October 8, 1884, by T. Pergande, at Washington, D. C.

Vanessa antiopa *Linn.* (Riley, in Scudder's Butterflies of New England, Vol. III, p. 1924.)

Gonia capitata *DeG*.....Hadena devastatrix *Brace.* Bred July 29, 1890, by C. P. Gillette, Ames, Iowa.

Laphygma frugiperda *S. & A.* Bred in 1880 by Lyne Starling, Sunnyside, Ark.

Peridroma saucia *Hueb.* Issued June 14, 1895, from a caterpillar received May 13 from Wm. Chappelow, Monrovia, Cal.

Hilarella fulvicornis *Coq*.....Acridiidid. Issued March 4, 1884, from a puparium found among locust eggs at Boscowen, N. H., September 14, 1883, by A. Koebele.

Hyphantrophaga hyphantriæ *Town*.....Eucaterva variaria *Grote.* (Townsend, Psyche, April, 1892, p. 258.)

Hyphantria cunea *Drury.* Bred by C. H. T. Townsend, September 1, 1891, at Las Cruces, N. Mex.

Vanessa milberti *Godt.* (Gillette, Trans. Amer. Ent. Soc., Vol. XXII, p. 75.)

Hypostena barbata *Coq*.....Coptocycla clavata *Fabr.* Bred from a larva, in July, 1897, by W. G. Johnson, College, Md.

Disonycha xanthomelæna *Dalm.* Bred June 26, 1897, by F. H. Chittenden, from an adult beetle collected at Washington, D. C.

Hypostena floridensis *Town*.....Blastobasis nubilella *Zell.* Issued June 26, 1895.

Schizocera ebena *Nort.* Issued August 19 and September 19, 23, and 27, 1887, from larvæ received August 18 from C. Werckle, Ocean Springs, Miss.

Hypostena tortricis *Coq*.....Tortricid. Bred August 15, 1890, by the writer from a caterpillar found July 26 in a nest of leaves on *Solanum douglasi* at Los Angeles, Cal.

Hypostena variabilis *Coq*.....Carpocapsa pomonella *Linn.*

Pyrausta penitalis *Grote.* Issued August 15, 1883, from a caterpillar collected August 1, by A. Koebele, in Washington, D. C.

Tenthredinid. Issued May 27, 1884, from a larva found on an alder tree; also August 20, 1896, from a larva found on *Ipomœa pandurata* in Missouri.

Jurinia metallica *Desv*.....Ecpantheria scribonia *Stoll.* Bred June 10, 1880, by Dr. Turner, Fort George, Fla.

Leskiomima tenera *Wied*.....Pyralid. Issued July 3, 1885, from a caterpillar found by T. Pergande, May 30, on a fern in Virginia.

Linnæmyia comta *Fall*.....Agrotis ypsilon *Rott.* Bred July 19, 1887, by the writer from a caterpillar received June 7 from Mrs. M. Stafford, Napa County, Cal.; the tachinid larva issued July 1.

Carneades messoria *Harr.* Bred by C. V. Piper, Pullman, Wash.

Macquartia pristis *Walk*.....Halisidota argentata *Pack.* Issued June 2, 1893, from a caterpillar received May 18 from A. Koebele, Aurora Mills, Oreg.

Limacodes sp. (Comstock, Psyche, June, 1892, p. 275.)

Masicera eufitchiæ *Town*.....*Eufitchia ribearia *Fitch.* (Gillette, Trans. Amer. Ent. Soc., Vol. XIX, p. 287.)

*Hyphantria cunea *Drury.* (Forbes, Psyche, June, 1893, p. 467.)

Masicera myoidæa *Desv*.....Arzama obliquata *G. & R.* Issued May 12 and 13, 1882, and June 21, 1884.

Hydrœcia nitela *Guen.* Issued July 26, 1890, from a caterpillar received July 25 from F. A. Brown, Everett, Mass.

Masicera tenthredinidarum *Town*.....*Tenthredinid. (Harrington, Trans. Amer. Ent. Soc., Vol. XIX, p. 286.)

Microphthalma disjuncta *Wied*..Lachnosterna arcuata *Smith.* Issued October 15, 1891, from a puparium found in the skin of a larva August 12, by T. Pergande, at Washington, D. C.

Myiophasia ænea *Wied*.....Balaninus nasicus *Say.* Issued July 22, 1895.

Chalcodermus sp. Bred by H. A. Morgan, Baton Rouge, La.

Conotrachelus juglandis *Lec.* Issued July 16, 1886, from a larva found by T. Pergande in Washington. Also June 29 and 30, 1896, from a larva received June 2 from J. G. Barlow, Cadet, Mo.

*(?)Leucania unipuncta *Haw.* (Forbes, Psyche, June, 1893, p. 467.)

Sphenophorus parvulus *Gyll.* (Forbes, *loc. cit.*)

Myiophasia robusta *Coq*.....Sphenophorus robustus *Horn.* Bred in October, 1886, by A. Koebele, from a larva found at Los Angeles, Cal.

Ocyptera carolinæ *Desv*.....*Acrididid. (Forbes, Psyche, June, 1893, p. 466.)

*(?)Leucania unipuncta *Haw.* (Forbes, loc. cit., p. 466.)

Pachyophthalmus floridensis *Town*.....Isodonta elegans *Sm.* Bred by Dr. A. Davidson, Los Angeles, Cal.

Pelopæus cementarius *Drury.* Bred by the writer in October, 1891, 14 specimens from a nest found November 11, 1890, near Rincon, Cal. Also bred July 28, 1892, by Dr. A. Davidson from the nest of a burrowing wasp at Los Angeles, Cal. Issued July 27, 1897, from a nest received that day from A. Oemler, Wilmington Island, Ga.

Pachyophthalmus floridensis *Town*.....*Trypoxylon politum *Say*. (Webster, Bull. Ohio Exper. Station, Technical Series, Vol. I, No. 3, p. 158.)

Pachyophthalmus signatus *Meig*.Pelopæus cementarius *Drury*. Bred by H. G. Hubbard, August 14, from a nest collected at Centerville, Fla.

Trypoxylon sp. Bred July 8, 1896, by E. A. Schwarz, from a nest found at Berkeley, W. Va.

Panzeria penitalis *Coq*.....Pyrausta penitalis *Grote*. Bred June 1, 1876, by Dr. Riley, at St. Louis, Mo., from a caterpillar collected the previous year. Also bred May 15, 1885, by Miss M. E. Murtfeldt, Kirkwood, Mo.

Panzeria radicum *Fabr*.....Hyphantria cunea *Drury*. Bred April 13, 1874, by O. Lugger, at St. Louis, Mo., from a cocoon found October 26, 1873. Also issued from a caterpillar collected in Washington, D. C.

Hyphantria sp. Issued March 26 and 30, 1896, from caterpillars collected August 18, 1895, on a persimmon tree at Riverview, Md., by T. Pergande.

Phorichæta sequax *Will*.....*Noctua fennica *Tausch*. (Cook, Notes on Injurious Insects, 1884.)

Noctuid. Bred in July, 1888, by A. Koebele, from a caterpillar collected at Summit, Cal.

Phorocera comstocki *Will*.....*Lophyrus sp. (Forbes, Psyche, June, 1893, p. 467.)

Megathymus yuccæ *Bd.-Lec.* Bred March 14, 1874, by O. Lugger, from a puparium received from South Carolina. Issued March 21 and 26, 1892, from a caterpillar received from J. H. Mellichamp, Bluffton, S. C.

*Pyrausta penitalis *Grote*. (Forbes, Psyche, June, 1893, p. 467.)

Phorocera doryphoræ *Riley*.....Doryphora 10-lineata *Say*. Issued July 30, 1897, from a larva collected by Frank Benton at Berwyn, Md.

Vanessa antiopa *Linn*. Bred by Dr. Riley, at St. Louis, Mo.

Phorocera leucaniæ *Coq*.....Leucania unipuncta *Haw*. Issued June 4, 1896, from a caterpillar received May 4 from J. C. Mackey, Ripley, Tenn.

Loxostege similalis *Guen*. Issued July 7 and 9, 1888, from caterpillars received from W. F. Avera, Camden, Ark.

Phorocera parva *Bigot*.....Tortrix citrana *Fern*. Bred by the writer May 13, 1887, from a caterpillar collected April 28 at Los Angeles, Cal.

Phorocera saundersii *Will*.....*Argynnis cybele *Fabr*. (Riley, in Scudder's Butterflies of New England, Vol. III, p. 1922.)

Phorocera tortricis *Coq*.....Tortricid. Bred by C. P. Gillette, from a caterpillar found on a cherry tree in Michigan.

Plectops melissopodis *Coq*.....Melissopus latiferreana *Wlshm*. Issued July 19, 1892. Also bred July 20, 1893, by Miss M. E. Murtfeldt, Kirkwood, Mo. Issued May 5, 21, 25, and 28, 1894, from caterpillars collected in April by T. Pergande in Washington, D. C.

Pseudochæta argentifrons *Coq* ..Bombycid. Bred by the writer May 23, 24, and 30, 1890, from a caterpillar found May 20 feeding on lichens on an apple tree at Santa Barbara, Cal.

Pseudochæta pyralidis *Coq* .....Pyralid. Issued March 24, 1880, from a caterpillar found in a nest of leaves on an oak tree.

Senotainia trilineata *v. d. W.*.....*(?) Leucania unipuncta *Haw.* (Forbes, Psyche, June, 1893, p. 467.)

Sphecius speciosus *Drury.* Issued August 7, 1890, from a nest found August 5, by T. Pergande, in Washington, D. C.

Siphona plusiæ *Coq* .....Plusia californica *Speyer.* Bred by the writer July 2, 1892, at Los Angeles, Cal.; the tachinid larva issued June 18 from a caterpillar collected June 17.

Spallanzania hesperidarum *Will.*.....Eudamus tityrus *Fabr.* (Harris, in Scudder's Butterflies of New England, Vol. III, p. 1917.)

Sturmia albifrons *Walk.*.....Ecpantheria scribonia *Stoll.* Bred by H. G. Hubbard, at Centerville, Fla.

Leucarctia aeræa *Drury.* Bred June 25 and July 2, 1881, by Dr. Riley, from a caterpillar received June 11 from A. P. Butler, Columbia, S. C. Issued March 20 and 26, 1883, from a cocoon received March 9 from Mrs. A. E. Bush, San Jose, Cal. Also bred by Mrs. W. Seliger, Hartford, Conn. Issued June 16, 1885, from a cocoon received from Murphy Brothers, Paris, Tex.

Sturmia distincta *Wied*.....Protoparce celeus *Hueb.* Bred June 1, 1880, by G. H. French, Carbondale, Ill.

Protoparce jamaicensis *Butl.* Bred September 7, 1889, by C. H. T. Townsend, Kingston, Jamaica.

Sphingid. Issued May 14, 1889, from a caterpillar found on an ash tree by G. H. Hathaway, Palestine, Tex. Also November 21, 1893, from a caterpillar received from the same source.

Sturmia harrisinæ *Coq*.....Harrisina americana *Harris.* Issued October 7, 1886.

Sturmia inquinata *v. d. W.*.....Ceratomia amyntor *Hueb.* Issued May 28 and 31, 1881.

Ceratomia undulosa *Walk.* Bred March 11, 1875, by Dr. Riley, at St. Louis, Mo., from a caterpillar collected the previous season. Also issued July 27 and 28, 1888.

Deilephila lineata *Fabr.* Bred October 1, 1892, by H. A. Morgan, Baton Rouge, La.

Hemileuca maia *Drury.* Issued September 25.

Philampelus achemon *Drury.* 18 specimens were bred from one chrysalis October 18, 1881, by Miss M. E. Murtfeldt, Kirkwood, Mo.

Protoparce carolina *Linn.* Bred May 17, 1880, by G. H. French, Carbondale, Ill. Also issued December 28, 1891, from a chrysalis collected November 21, by Dr. Riley, in Colorado.

Protoparce celeus *Hueb.* Bred in April, 1871, by Dr. Riley, at St. Louis, Mo.

Protoparce cingulata *Fabr.* Issued January 26 and 27, 1882, from a chrysalis received December 17, 1881, from J. C. Neal, Archer, Fla.

Sturmia phyciodis *Coq*.....Phyciodes sp. Issued October 7, 1889, from a caterpillar collected September 15, by T. Pergande, at Piney Point, Md.

Sturmia schizurae *Coq*.....Schizura ipomœæ *Doubl.* Bred in May, 1895, by C. V. Piper, Pullman, Wash.

Tachina mella *Walk*.....Acronycta populi *Riley.* Issued September 26 and December 7, 1874.

Arctia phyllira *Drury.* Issued April 7, 1882, from a caterpillar collected March 15, by A. Koebele, at Archer, Fla.

Clisiocampa disstria *Hueb.* (Harvey, Psyche, May, 1891, p. 84.)

Clisiocampa sp. Issued July 10, 1888, from a caterpillar received from Evanston, Wyo. Also October 2, 1888, from one received June 25, from T. D. A. Cockerell, West Cliff, Colo. Bred by the writer from a caterpillar found on an oak tree near Los Angeles, Cal.

Clisiocampa thoracica *Stretch.* Bred in 1890 by A. Koebele, from a caterpillar found at Glen Ellen, Cal.

Leucarctia acræa *Drury.* Bred July 6, 7, and 8, by F. F. Crevecoeur, Onaga, Kans.

Orgyia leucostigma *S. & A.* Issued September 16, 1895, from a cocoon collected September 7, at Washington, D. C. Also issued in July, 1896, from caterpillars collected in the same locality.

*Porthetria dispar *Linn.* (Fernald, The Gypsy Moth, p. 387.)

Pyrrharctia isabella *S. & A.* Issued June 14. Bred June 10, 1892, by W. Brodie, Toronto, Canada.

Tachina robusta *Town*.....Agrotis ypsilon *Rott.* Issued April 12, 1873.

Clisiocampa sp. Bred by A. Koebele from caterpillars collected in Sonoma County, Cal.

Tachina rustica *Fall*.....*Tenthredinid. (Harrington, Trans. Amer. Ent. Soc., Vol. XIX, p. 285.)

Trichophora miscelli *Coq*.....Adisophanes miscellus *Grote.* Bred in 1886, by A. Koebele, at Los Angeles, Cal.

Trichopoda pennipes *Fabr*.....Anasa tristis *DeG.* Issued September 12 and 13, 1894, from an adult received from M. P. Barnard, Kennett Square, Pa.

Trichopoda plumipes *Fabr*.....Dissosteira venusta *Stål.* Bred by A. Koebele, August 30, 1887, from an adult collected at St. Helena, Cal.

Winthemia 4-pustulata *Fabr*....Alypia octomaculata *Hueb.* Issued July 28, 1897, from a caterpillar received July 13 from C. G. Griswold, Brooklyn, N. Y.

Attacus cecropia *Linn.* Bred by Dr. Riley at St. Louis, Mo.

Bombycid. Issued October 21, 1882, from a caterpillar found on a birch tree.

Datana ministra *Drury.*

*Deilephila lineata *Fabr.* (Riley, Can. Entomologist, Vol. XIX, p. 165.)

Feltia herilis *Grote.* Issued June 6, 1895, from a caterpillar received May 8 from Spencer Merrill, Mine la Motte, Mo.

Winthemia 4-pustulata *Fabr*....Halisidota tessellata *S. & A.* Issued August 14, 1896, from a caterpillar received August 1 from L. Collins, Brooklyn, N. Y.

* Hemaris diffinis *Boisd.* (Forbes, Psyche, June, 1893, p. 467.)

Laphygma frugiperda *S. & A.*

Leucania unipuncta *Haw.* Issued June 12, 13, 14, and 18, 1879, from caterpillars collected by Dr. Howard near Portsmouth, Va. Also, August 12, 1880, from a caterpillar received August 2 from R. A. Ayres, Stillville, Va. Also June 21, 22, and 23, 1894, from caterpillars received June 7, from E. P. Hatcher, Chester, Pa. And July 23, 1896, from a caterpillar collected at Agawam, Mass. Also bred in 1896, by M. V. Slingerland, Ithaca, N. Y.

Orgyia leucostigma *S. & A.* Issued in October, 1895, and April 14, 1896, from caterpillars collected at Washington, D. C.

Peridroma saucia *Hueb.* Issued June 10, 1872.

Protoparce celeus *Hueb.* Bred in April, 1871, by Dr. Riley, from a caterpillar collected the previous year at St. Louis, Mo.

Telea polyphemus *Cram.* Issued May 29, 1882, from a caterpillar collected September 5, 1881, by B. P. Mann, in Washington, D. C.

II.—Hosts and Their Parasites.

[The breeding records are omitted in this part of the list.]

Host insects.	*Parasites.*
HYMENOPTERA.	
Bombus fervidus *Fabr*	Brachycoma davidsoni *Coq.*
Bombus sp	Frontina frenchii *Will.*
Isodonta elegans *Smith*	Pachyophthalmus floridensis *Town.*
Lophyrus abbotii *Leach*	Admontia demylus *Walk.*
Lophyrus lecontei *Fitch*	Admontia demylus *Walk.*
Lophyrus sp	Euphorocera claripennis *Macq.*
	Exorista petiolata *Coq.*
	* Phorocera comstocki *Will.*
Pelopæus cementarius *Drury*	Pachyophthalmus floridensis *Town.*
	Pachyophthalmus signatus *Meig.*
Schizocera ebena *Nort*	Hypostena floridensis *Town.*
Sphecius speciosus *Drury*	Senotainia trilineata *v. d. W.*
Tenthredinid	Hypostena variabilis *Coq.*
	* Masicera tenthredinidarum *Town.*
	* Tachina rustica *Fall.*
Trypoxylon politum *Say*	* Pachyophthalmus floridensis *Town.*
Trypoxylon sp	Pachyophthalmus signatus *Meig.*
HEMIPTERA.	
Anasa tristis *DeG*	Trichopoda pennipes *Fabr.*

ORTHOPTERA.

Acridiidid	*Hilarella fulvicornis *Coq.*
	Trichopoda plumipes *Fabr.*
	Ocyptera carolinæ *Desv.*
Chortophaga viridifasciata *DeG.*	Acemyia dentata *Coq.*
Dissosteira carolina *Linn.*	Frontina frenchii *Will.*
Dissosteira venusta *Stål*	Trichopoda plumipes *Fabr.*

COLEOPTERA.

Balaninus nasicus *Say*	Myiophasia ænea *Wied.*
Calosoma calidum *Fabr.*	Biomyia georgiæ *Br. & Berg.*
Calosoma peregrinator *Guér.*	Biomyia georgiæ *Br. & Berg.*
Chalcodermus sp.	Myiophasia ænea *Wied.*
Chrysomela multipunctata *Say*	Euphorocera claripennis *Macq.*
Conotrachelus juglandis *Lec.*	Myiophasia ænea *Wied.*
Coptocycla clavata *Fabr.*	Hypostena barbata *Coq.*
Diabrotica 12-punctata *Oliv.*	Celatoria diabroticæ *Shimer.*
Diabrotica soror *Lec.*	Celatoria diabroticæ *Shimer.*
Diabrotica vittata *Fabr.*	Celatoria diabroticæ *Shimer.*
Disonycha xanthomelæna *Dalm.*	Hypostena barbata *Coq.*
Doryphora 10-lineata *Say*	Phorocera doryphoræ *Riley.*
Epilachna borealis *Fabr.*	Euphorocera claripennis *Macq.*
Lachnosterna arcuata *Smith*	Eutrixa masuria *Walk.*
	Microphthalma disjuncta *Wied.*
Lachnosterna inversa *Horn*	Cryptomeigenia theutis *Walk.*
Sphenophorus parvulus *Gyll.*	*Myiophasia ænea *Wied.*
Sphenophorus robustus *Horn*	Myiophasia robusta *Coq.*

LEPIDOPTERA.

Acronycta dactylina *Grote*	Amobia distincta *Town.*
Acronycta hamamelis *Guen.*	Euphorocera claripennis *Macq.*
	Exorista eudryæ *Town.*
	Exorista lobeliæ *Coq.*
Acronycta lobeliæ *Guen.*	Exorista lobeliæ *Coq.*
Acronycta luteicoma *G. & R.*	Exorista eudryæ *Town.*
Acronycta occidentalis *G. & R.*	Archytas aterrima *Desv.*
Acronycta ovata *Grote*	Archytas aterrima *Desv.*
Acronycta populi *Riley*	Tachina mella *Walk.*
Acronycta sp.	Exorista eudryæ *Town.*
	Exorista lobeliæ *Coq.*
Adisophanes miscellus *Grote*	Trichophora miscelli *Coq.*
Agraulis vanillæ *Linn.*	Euphorocera claripennis *Macq.*
Agrotis sp.	Chætogædia crebra *v. d. W.*
	Phorichæta sequax *Will.*
Agrotis ypsilon *Rott.*	Exorista eudryæ *Town.*
	Frontina archippivora *Will.*
	Linnæmyia comta *Fall.*
	Tachina robusta *Town.*
Aletia argillacea *Hueb.*	Euphorocera claripennis *Macq.*
	Frontina aletiæ *Riley.*
Alypia octomaculata *Hueb.*	Exorista eudryæ *Town.*
	Winthemia 4-pustulata *Fabr.*
Anisota senatoria *S. & A.*	Euphorocera claripennis *Macq.*
	Frontina frenchii *Will.*

Anisota virginiensis *Drury*	Frontina frenchii *Will.*
Apatura celtis *Bd.-Lec.*	*Euphorocera claripennis *Macq.*
Apatura clyton *Bd.-Lec.*	Euphorocera claripennis *Macq.*
Arachnis picta *Pack*	Blepharipeza adusta *Loew.*
	Exorista cheloniæ *Rond.*
Arctia docta *Walk.*	Euphorocera claripennis *Macq.*
	Exorista cheloniæ *Rond.*
Arctia phyllira *Drury*	Tachina mella *Walk.*
Arctia sp.	Exorista affinis *Fall.*
Argynnis cybele *Fabr.*	*Phorocera saundersii *Will.*
Arzama obliquata *G. & R.*	Masicera myoidæa *Desv.*
Attacus cecropia *Linn*	Frontina frenchii *Will.*
	Winthemia 4-pustulata *Fabr.*
Attacus sp	Frontina frenchii *Will.*
Blastobasis nubilella *Zell.*	Hypostena floridensis *Town.*
Boarmia pampinaria *Guen*	Exorista boarmiæ *Coq.*
Bombycid	Pseudochæta argentifrons *Coq.*
	Winthemia 4-pustulata *Fabr.*
Carneades messoria *Harris*	Aphria ocypterata *Town.*
	Linnæmyia comta *Fall.*
Carneades sp.	Chætogædia monticola *Bigot.*
Carpocapsa pomonella *Linn.*	Hypostena variabilis *Coq.*
Ceratomia amyntor *Hueb*	Sturmia inquinata *r. d. W.*
Ceratomia catalpæ *Boisd.*	Euphorocera claripennis *Macq.*
	Frontina frenchii *Will.*
Ceratomia undulosa *Walk.*	Exorista ceratomiæ *Coq.*
	Sturmia inquinata *r. d. W.*
Cerura sp.	Archytas aterrima *Desv.*
	Frontina aletiæ *Riley.*
Chrysophanus xanthoides *Boisd.*	*Exorista confinis *Fall.*
Citheronia regalis *Fabr*	Belvosia bifasciata *Fabr.*
	Frontina frenchii *Will.*
Clisiocampa americana *Harr.*	Frontina frenchii *Will.*
Clisiocampa californica *Stretch.*	*Archytas analis *Fabr.*
	Frontina frenchii *Will.*
Clisiocampa constricta *Stretch.*	Blepharipeza adusta *Loew.*
	Frontina archipivora *Will.*
	Frontina frenchii *Will.*
Clisiocampa disstria *Hueb.*	Euphorocera claripennis *Macq.*
	*Frontina frenchii *Will.*
	Tachina mella *Walk.*
Clisiocampa pluvialis *Dyar.*	Frontina archippivora *Will.*
Clisiocampa sp.	Tachina mella *Walk.*
	Tachina robusta *Town.*
Clisiocampa thoracica *Stretch.*	Blepharipeza adusta *Loew.*
	Exorista futilis *O. S.*
	Frontina frenchii *Will.*
	Tachina mella *Walk.*
Crocota rubicundaria *Hueb.*	Euphorocera claripennis *Macq.*
Danais archippus *Fabr.*	Frontina archippivora *Will.*
Dasylopha anguina *S. & A.*	Frontina aletiæ *Riley.*
	Frontina frenchii *Will.*
Datana contracta *Walk.*	Euphorocera claripennis *Macq.*
Datana ministra *Drury*	Frontina frenchii *Will.*
	Winthemia 4-pustulata *Fabr.*
Datana sp.	Frontina frenchii *Will.*

Deilephila lineata *Fabr.*	Sturmia inquinata *v. d. W.*
	* Winthemia 4-pustulata *Fabr.*
Dendrobinus howardi *Dyar*	Exorista confinis *Fall.*
Dryocampa rubicunda *Fabr.*	* Belvosia bifasciata *Fabr.*
	Frontina frenchii *Will.*
Ecpantheria scribonia *Stoll.*	Jurinia metallica *Desv.*
	Sturmia albifrons *Walk.*
Empretia stimulea *Clem.*	Euphorocera claripennis *Macq.*
Eubolina? sp	Euphorocera claripennis *Macq.*
Eucaterva variaria *Grote*	* Hyphantrophaga hyphantriæ *Town.*
Euchætes egle *Drury*	* Frontina frenchii *Will.*
Euclea cippus *Cram*	Exorista blanda *O. S.*
Eudamus tityrus *Fabr*	* Spallanzania hesperidarum *Will.*
Eudryas unio *Hueb*	Exorista eudryæ *Town.*
Eufitchia ribearia *Fitch*	* Masicera eufitchiæ *Town.*
Feltia herilis *Grote*	Euphorocera claripennis *Macq.*
	Winthemia 4-pustulata *Fabr.*
Hadena apamiformis *Grote*	Exorista futilis *O. S.*
Hadena devastatrix *Brace*	Gonia capitata *DeG.*
Hadena lignicolor *Guen.*	* Echinomyia algens *Wied.*
Halisidota argentata *Pack*	Macquartia pristis *Walk.*
Halisidota edwardsii *Pack*	Blepharipeza adusta *Loew.*
Halisidota maculata *Harr*	Frontina aletiæ *Riley.*
Halisidota tessellata *S. & A.*	Euphorocera claripennis *Macq.*
	Frontina aletiæ *Riley.*
	Winthemia 4-pustulata *Fabr.*
Harrisina americana *Harr*	Euphorocera claripennis *Macq.*
	Sturmia harrisinæ *Coq.*
Heliothis armiger *Hueb.*	Frontina armigera *Coq.*
	Frontina frenchii *Will.*
Hemaris diffinis *Boisd*	* Winthemia 4-pustulata *Fabr.*
Hemileuca artemis *Pack*	Euphorocera claripennis *Macq.*
Hemileuca electra *Wright*	Euphorocera claripennis *Macq.*
Hemileuca maia *Drury*	Sturmia inquinata *v. d. W.*
Hemileuca sp	Belvosia bifasciata *Fabr.*
Heterocampa marthesia *Cram.*	Exorista eudryæ *Town.*
Hydrœcia nitela *Guen.*	Masicera myoidæa *Desv.*
Hyperchiria io *Fabr*	Exorista eudryæ *Town.*
	Frontina frenchii *Will.*
Hyphantria cunea *Drury*	Hyphantrophaga hyphantriæ *Town.*
	* Masicera eufitchiæ *Town.*
	Panzeria radicum *Fabr.*
Hyphantria sp	Panzeria radicum *Fabr.*
Hyponomeuta multipunctella *Clem.*	Exorista pyste *Walk.*
Hypsoropha hormos *Hueb.*	Frontina frenchii *Will.*
Ichthyura inclusa *Hueb.*	Frontina frenchii *Will.*
Isa inornata *G. & R.*	Exorista isæ *Coq.*
Lagoa crispata *Pack*	Archytas aterrima *Desv.*
Lagoa opercularis *S. & A.*	Exorista flavirostris *v. d. W.*
	Frontina aletiæ *Riley.*
Lagoa sp	Euphorocera claripennis *Macq.*
Laphygma flavimaculata *Harr.*	Frontina archippivora *Will.*
Laphygma frugiperda *S. & A.*	Gonia capitata *DeG.*
	Winthemia 4-pustulata *Fabr.*

Leucania unipuncta *Haw*	Belvosia unifasciata *Desv.*
	*(?)Cistogaster immaculata *Macq.*
	*(?)Myiophasia ænea *Wied.*
	*(?)Ocyptera carolinæ *Desv.*
	Phorocera leucaniæ *Coq.*
	*(?)Senotainia trilineata *v. d. W.*
	Winthemia 4-pustulata *Fabr.*
Leucarctia acræa *Drury*	*Blepharipeza adusta *Loew.*
	Sturmia albifrons *Walk.*
	Tachina mella *Walk.*
Limacodes sp	*Macquartia pristis *Walk.*
Loxostege similalis *Guen*	Exorista boarmiæ *Coq.*
	Phorocera parva *Bigot.*
Lycæna exilis *Boisd*	Exorista confinis *Fall.*
Lycæna pseudargiolus *Bd.-Lec.*	*Exorista confinis *Fall.*
Lycæna sp	Exorista confinis *Fall.*
Mamestra trifolii *Rott*	Euphorocera claripennis *Macq.*
Megathymus yuccæ *Bd.-Lec.*	Phorocera comstocki *Will.*
Melissopus latiferreana *Wlshm.*	Plectops melissopodis *Coq.*
Mineola indiginella *Zell*	Exorista pyste *Walk.*
Nisoniades brizo *Bd.-Lec*	*Exorista blanda *O. S.*
Noctua fennica *Tausch*	* Phorichæta sequax *Will.*
Noctuid	Phorichæta sequax *Will.*
Œdemasia concinna *S. & A.*	Euphorocera claripennis *Macq.*
Omphalocera cariosa *Led*	Exorista ceratomiæ *Coq.*
	Exorista flavirostris *v. d. W.*
Orgyia leucostigma *S. & A.*	Euphorocera claripennis *Macq.*
	Exorista griseomicans *v. d. W.*
	Exorista lobeliæ *Coq.*
	Frontina aletiæ *Riley.*
	Frontina frenchii *Will.*
	Tachina mella *Walk.*
	Winthemia 4-pustulata *Fabr.*
Papilio thoas *Linn*	Frontina irrequieta *Walk.*
Papilio turnus *Linn*	*Frontina frenchii *Will.*
Pempelia sp	Exorista ceratomiæ *Coq.*
Peridroma saucia *Hueb*	Chætogædia monticola *Bigot.*
	Gonia capitata *DeG.*
	Winthemia 4-pustulata *Fabr.*
Phasiana neptata *Guen*	Euphorocera claripennis *Macq.*
Philampelus achemon *Drury*	Sturmia inquinata *v. d. W.*
Philampelus vitis *Linn*	Frontina violenta *Walk.*
Phyciodes sp	Sturmia phyciodis *Coq.*
Pieris rapæ *Linn*	*Exorista vulgaris *Fall.*
Plusia californica *Speyer*	Siphona plusiæ *Coq.*
Plodia sp	Epigrimyia floridensis *Town.*
Porthetria dispar *Linn*	*Tachina mella *Walk.*
Protoparce carolina *Linn*	Sturmia inquinata *v. d. W.*
Protoparce celeus *Hueb*	Sturmia distincta *Wied.*
	Sturmia inquinata *v. d. W.*
	Winthemia 4-pustulata *Fabr.*
Protoparce cingulata *Fabr*	Sturmia inquinata *v. d. W.*
Protoparce jamaicensis *Butler*	Sturmia distincta *Wied.*
Pyralid	Exorista ceratomiæ *Coq.*
	Exorista pyste *Walk.*
	Frontina frenchii *Will.*

Pyralid	Leskiomima tenera *Wied.*
	Pseudochæta pyralidis *Coq.*
Pyrameis atalanta *Linn*	Exorista eudryæ *Town.*
	*Exorista futilis *O. S.*
Pyrameis cardui *Linn*	Chætogædia monticola *Bigot.*
	*Exorista blanda *O. S.*
	Frontina archippivora *Will.*
	*Frontina frenchii *Will.*
Pyrameis carye *Hueb*	Frontina archippivora *Will.*
Pyrausta penitalis *Grote*	*Exorista vulgaris *Fall.*
	Hypostena variabilis *Coq.*
	Panzeria penitalis *Coq.*
	*Phorocera comstocki *Will.*
Pyrrharctia isabella *S. & A*	Tachina mella *Walk.*
Retinia sp	Admontia retiniæ *Coq.*
Schizura ipomœæ *Doubl*	Sturmia schizuræ *Coq.*
Schizura unicornis *S. & A*	*Frontina frenchii *Will.*
Smerinthus cerisyi *Kirby*	Frontina frenchii *Will.*
Sphingid	Sturmia distincta *Wied.*
Taeniocampa rufula *Grote*	Chætogædia crebra *r. d. W.*
Telea polyphemus *Cram*	Frontina frenchii *Will.*
	Winthemia 4-pustulata *Fabr.*
Thecla autolycus *Edw*	*Exorista pyste *Walk.*
Thecla calanus *Hueb*	*Exorista confinis *Fall.*
Tortrix citrana *Fern*	Phorocera parva *Bigot.*
Tortricid	Exorista pyste *Walk.*
	Hypostena tortricis *Coq.*
	Phorocera tortricis *Coq.*
Vanessa antiopa *Linn*	*Euphorocera claripennis *Macq.*
	*Frontina violenta *Walk.*
	Phorocera doryphoræ *Riley.*
Vanessa milberti *Godt*	*Hyphantrophaga hyphantriæ *Town.*

CLASSIFICATION.

Probably no single family of Diptera has received greater consideration in Europe than the Tachinidæ, and yet, strange as this may seem, no other family at the present time is in greater disorder. Several authors accord them only subfamily rank, but it appears desirable to consider them as a distinct family, although their relationship to the Dexidæ and Sarcophagidæ is a very intimate one. They may be recognized by the bare, or at least never plumose, antennal arista. They are commonly divided into five subfamilies, and these have by one or two writers even been accorded family rank. The characters employed in separating them are as follows:

Abdomen destitute of stout macrochætæ:
- With only four abdominal segments ..... Gymnosominæ.
- With five or six abdominal segments ..... Phasinæ.

Abdomen bearing stout macrochætæ:
- With only four abdominal segments ..... Tachininæ.
- With five abdominal segments—
  - Abdomen not clavate ..... Phaninæ.
  - Abdomen clavate, narrow at the base ..... Ocypterinæ.

This classification looks very nice on paper, but when we undertake to apply it to the specimens themselves, then the difficulty arises. In the first place, in many species the macrochaetæ are so reduced in size that it is no easy matter to decide as to whether they should be considered as macrochaetæ or simply as bristly hairs. Then again, the males of several species have five visible abdominal segments, while their females have only four; and, conversely, the females of a few species have five and their males only four. This difference is due to the greater or less development of what, in those with only four abdominal segments, is the first segment of the genitalia, and as this varies in size in the different species, it is not always easy to decide as to whether to regard it as belonging to the genitalia or as forming a distinct abdominal segment. In at least one genus (Hemyda), the fourth abdominal segment is so reduced in size as to appear as a part of the genitalia, and thus there are apparently only three abdominal segments. These differences, therefore, are developmental rather than structural. If there were differences in habits between these subfamilies there would then be some reason for retaining these divisions, but the differences are so slight that they hardly enter into this consideration. Thus the Tachininæ are known to attack the Hymenoptera, Lepidoptera, Diptera, Coleoptera, and Orthoptera, but not the Hemiptera; the Phasiinæ and Ocypterinæ attack the Coleoptera, Orthoptera, and Hemiptera; the Gymnosominæ attack the Hemiptera only, and the Phaninæ the Coleoptera. It will thus be seen that all of these subfamilies, with the exception of the Gymnosominæ, attack Coleoptera; that all except the Tachininæ and Phaninæ prey upon the Hemiptera; while the Tachininæ is the only one known to attack the Hymenoptera, Lepidoptera, and Diptera. In point of numbers the Tachininæ outnumber all of the other subfamilies put together by at least fifteen species to one, and to this fact alone is apparently due the greater diversity in regard to their hosts.

The most recent attempt at a classification of the Tachinidæ of the world is by Brauer and Bergenstamm, of Vienna, Austria. These authors, who are new workers in this field, had access to the types of most of the species described by Meigen, Wiedemann, Schiner, Rondani, Jaennicke, and several by Macquart, and their figures and redescriptions of many of the species can not but prove to be great aids to future students of this group. In the first part of their work[1] they threw together in one mass the five families: Œstridæ, Tachinidæ, Dexidæ, Sarcophagidæ, and Muscidæ, and out of this chaotic mass they erected *fifty-five* families, which were duly given family names; but this classification did not prove satisfactory to the authors, so in the third or last part of their systematic work they again threw all the families into one and divided it into *sixty* groups, which they call sections.

[1]Published in the Denkschriften der Mathematisch-Naturwissenchaftlichen Classe der Kaiserlichen Akademie der Wissenschaften for 1889.

So far as our own fauna is concerned, the species are too nearly related to one another, both structurally and also in regard to their habits, to permit of being separated into smaller groups with any degree of satisfaction.

TERMS USED IN DESCRIBING TACHINIDÆ.

Only a few terms employed in the present work will require an explanation, since in most cases the terms used in designating the various parts of the specimens are the same as those employed in the other departments of entomology. The term *macrochæta* is used to designate the stout bristles which arise from a convex and usually polished base; they are regularly arranged in pairs, rows, or otherwise, and afford excellent specific and sometimes even generic characters. The *frontal bristles* are composed of two rows of such macrochætæ, which descend from the very top of the head to or below the insertion of the antennæ. The *ocellar bristles* are composed of a pair of macrochætæ placed among the ocelli, but they are absent in several species. The *orbital bristles* are two or more pairs of forwardly directed macrochætæ, situated between the frontal bristles and the eyes; they are usually present in female specimens, and sometimes also in the males. Beneath the antennæ is a cavity known as the *facial depression*, bounded on the sides by the *facial ridges;* at the lower ends of the ridges is a pair of macrochætæ called the *vibrissæ*. The *cheeks* are between the lower ends of the eyes and the opening of the mouth. The *antennæ*, as well as their two *aristæ*, are always composed of three joints, but sometimes the basal joint is extremely short.

On the thorax the two rows of macrochætæ in the middle of the dorsum are known as *acrostichal*, and the next two rows are the *dorsal*, although these four rows are sometimes called the *dorso-centrals;* these rows usually extend the entire length of the thorax, those in front of the transverse suture being called the *præsutural* and those behind it the *postsutural;* but when the latter term is used in the accompanying pages it applies to those in the outer rows only. The row on either side of these four is called the *intra-alar;* this row sometimes extends in front of the transverse suture by a single macrochæta, which has received the name of the *præsutural intra-alar* bristle. One European author, Mr. Girschner, proposes to separate the Tachinidæ into two groups according to whether this bristle is present or absent, but in some of our species it is present in some specimens but absent in others that belong to the same species; this character, therefore, is not of specific, much less of subfamily, importance. The *sternopleural* macrochætæ are situated on the upper part of the transverse, more or less triangular, piece located on the sides of the thorax between the front and middle coxæ; when only one is present, this is the posterior; when two, these are the anterior and the posterior; when three, two are in front and one behind; and when four, these are in a downwardly curving row.

The macrochætæ on the dorsum of the abdomen are called *discal*

when situated near the middle of the length of the segment, and *marginal* when located near its posterior margin.

The veins and cells of the wings are called by the same terms as in the other families of Diptera, except that the first posterior cell is commonly called the *apical*, and the portion of the fourth vein beyond the bend is sometimes termed the *apical crossvein*.

TABLE OF GENERA.

The only attempt at publishing a synoptic table, comprising all of the genera reported as occurring in North America, is that by Mr. C. H. T. Townsend, in the Proceedings of the Entomological Society of Washington[1] and in the Transactions of the American Entomological Society.[2] That in the former publication is a reprint of the table given by Dr. Schiner,[3] and that in the latter a reprint of the one by F. M. van der Wulp,[4] both modified so as to comprise only the North American genera. As the author did not have access to specimens of many of these genera, and as the characters he uses are in many cases not of specific, much less of generic, value, the result is not altogether satisfactory, and I have therefore constructed an entirely new table, which, however, includes only those genera from America north of Mexico of which I have examined representatives. A list of the remaining genera reported from this region is given at the end of the table.

In some cases doubt will arise as to which section a given genus should be referred, but in such cases, at least so far as they occur to the writer, the genus is placed in both sections:

1. Abdomen provided with true macrochætæ ..... 8.
   Abdomen destitute of macrochætæ, apical cell ending at or near the extreme wing tip ..... 2.
2. Upper side of abdomen very convex, abdomen subhemispherical, sides of face bare ..... 3.
   Upper side of abdomen flat, or the abdomen elongated and cylindrical ..... 4.
3. Antennæ not reaching lower third of face ..... (p. 42) *Cistogaster*.
   Antennæ reaching lowest fifth of face, or even lower ..... (p. 43) *Gymnosoma*.
4. Hind tibiæ outwardly not ciliate with scales ..... 5.
   Hind tibiæ ciliate with nearly erect scales, sides of face bare .. (p. 47) *Trichopoda*.
5. Sides of face bare ..... 6.
   Sides of face bristly, third and fourth veins almost equally converging toward their tips, which meet or almost meet each other ..... (p. 49) *Gymnophania*.
6. Proboscis at most slightly longer than the head, geniculate near the base only, antennæ at most reaching slightly below middle of face, apical cell closed, the petiole at least twice as long as the small crossvein 7
   Proboscis bristle like, almost as long as the body, geniculate near the base and also near the middle ..... (p. 49) *Eusiphona*.

[1] Vol. II, pp. 92 to 99; April 2, 1891.

[2] Vol. XIX, pp. 134 to 141; June, 1892.

[3] Fauna Austriaca, Diptera, Vol. I, pp. LXX to LXXI; 1862.

[4] Biologia Centrali-Americana, Diptera, Vol. II, pp. 5 to 7, and 41 to 44; 1888 and 1890.

7. Sides of front hairy except a narrow space along each eye .....(p. 44) *Alophora.*
Sides of front bare except two or three rows of hairs along each side of the frontal vitta.....(p. 43) *Phorantha.*
8. Palpi present, well developed ..... 17.
Palpi absent or rudimentary, facial ridges never bristly on more than the lowest fourth, first vein bare ..... 9.
9. Eyes bare, or with indistinct, short, sparse hairs..... 10.
Eyes distinctly hairy, apical cell ending far before the wingtip, sides of face bare, upper edge of third antennal joint concave .....(p. 86) *Linnæmyia.*
10. Face on the sides bearing hairs or macrochætæ..... 11.
Face on the sides bare ..... 11.
11. Head at the vibrissæ as long as at base of antennæ, apical cell ending far before the extreme wingtip ..... 12.
Head at vibrissæ much shorter than at base of antennæ, sides of face bare except the row of three or four macrochætæ on each; apical cell ending close to the extreme wingtip .....(p. 126) *Atrophopalpus.*
12. With one or more stout macrochætæ on each side of face near lower end of the eye..... 13.
Without such macrochætæ, body very robust .....(p. 145) *Epalpus.*
13. Each side of the face bearing one macrochæta, body slender..(p. 139) *Trichophora.*
Each side bearing two or three macrochætæ, body robust....(p. 140) *Cuphocera.*
14. Proboscis at most only slightly longer than height of head..... 15.
Proboscis over twice as long as height of head, head at vibrissæ longer than at base of antennæ, apical cell ending close to the wingtip.....(p. 73) *Beskia.*
15. Horizontal diameter of head at the vibrissæ as long as at base of antennæ... 16
Horizontal diameter of head at vibrissæ much shorter than at base of antennæ, apical cell open, ending considerably before the extreme wingtip..(p. 66) *Ervia.*
16. Apical cell open, ending at the extreme wingtip .....(p. 67) *Apinops.*
Apical cell closed, its petiole longer than the small crossvein, ending far before the extreme wingtip.....(p. 86) *Ocyptera.*
17. First vein bare ..... 30.
First vein wholly or partly bristly, two or more pairs of frontal bristle below base of antennæ, vibrissæ nearly on a level with front edge of oral margin, antennæ reaching at least to lowest fifth of face..... 18.
18. Eyes bare or with indistinct short sparse hairs ..... 20.
Eyes distinctly hairy, head at the vibrissæ noticeably shorter than at base of antennæ, sides of face bare, apical cell open..... 19.
19. Facial ridges bristly on more than the lower half, third vein bearing from one to three bristles near its base.....(p. 65) *Hypochæta.*
Facial ridges never bristly on more than the lowest fourth, third vein bristly more than halfway from base to the small crossvein .....(p. 90) *Exoristoides.*
20. Diameter of head at vibrissæ as long as at base of antennæ ..... 26.
Diameter of head at vibrissæ noticeably shorter than at base of antennæ .... 21.
21. Tip of apical cell far before the extreme tip of wing..... 23.
Tip of apical cell at or close to the extreme tip of wing..... 22.
22. Penultimate joint of arista over three times as long as broad, facial ridges never bristly on more than the lowest fifth.....(p. 57) *Plectops.*
Penultimate joint of arista not, or only slightly, longer than broad, facial ridges bristly on at least the lower half.....(p. 59) *Chætophleps.*
23. Apical cell open ..... 24.
Apical cell closed and long petiolate.....(p. 126) *Metachæta.*
24. Sides of face destitute of rows of macrochætæ..... 25.
Sides of face each bearing a row of macrochætæ which descends almost to the lower end of the eye .....(p. 127) *Chætoplagia.*

25. Bend of fourth vein furnished with a long appendage, hind crossvein unusually oblique, lowest frontal bristles directed downward, proboscis thick, fleshy, labella large ..... (p. 78) *Plagia.*
Bend of fourth vein destitute of an appendage, hind crossvein nearly at right angles to the fourth vein ..... (p. 118) *Houghia.*
26. Fourth vein ending at or close to the extreme tip of wing ..... 27.
Fourth vein ending less than halfway from tip of second vein to the extreme tip of wing, proboscis slender, labella very small, lowest frontal bristles directed upward ..... (p. 78) *Siphoplagia.*
27. Third vein bristly at least almost to the small crossvein, proboscis at most only slightly longer than height of head ..... 28.
Third vein bristly on less than one-third of the distance from its base to the small crossvein, proboscis twice as long as height of head ..(p. 74) *Epigrimyia.*
28. Arista pubescent, the longest scarcely half as long as the greatest diameter of the arista ..... 29.
Arista bearing short hairs, the longest of which are slightly longer than its greatest diameter ..... (p. 67) *Leskiomima.*
29. Frontal vitta next the antennæ nearly four times as wide as either side of the front, third vein never bristly to the small crossvein, scutellum bearing only two pairs of long marginal macrochætæ ..... (p. 59) *Lasioneura.*
Frontal vitta next the antennæ at most twice as wide as either side of the front, third vein bristly almost to its tip, scutellum bearing three pairs of long marginal macrochætæ ..... (p. 58) *Actia.*
30. Face on the lower half of its sides bare ..... 79.
Face bearing macrochætæ or bristly hairs on at least a portion of the lower half of its sides ..... 31.
31. Tip of apical cell far before the extreme tip of wing ..... 40.
Tip of apical cell at or close to the extreme tip of wing, proboscis beyond the basal articulation at most only slightly longer than height of head ..... 32.
32. Abdomen subopaque, partly or wholly covered with grayish pollen ..... 33.
Abdomen largely or wholly shining and destitute of pollen ..(p. 50) *Myiophasia.*
33. Eyes bare, or with indistinct, short, sparse hairs ..... 34.
Eyes distinctly hairy, antennæ as long as the face, facial ridges never bristly on more than the lowest fourth ..... (p. 52) *Eulasiona.*
34. Frontal bristles to the number of from one to three pairs beneath base of antennæ; antennæ at least three-fourths as long as the face ..... 37.
Frontal bristles not descending beneath base of antennæ; antennæ less than two-thirds as long as face, cheeks two-thirds as broad as eye-height ..(p. 51) *Phyto.*
35, 36. (Omitted.)
37. First posterior cell open, or, if closed, short petiolate ..... 38.
First posterior cell closed and long petiolate, the petiole as long as the hind crossvein, third vein bristly almost to the small crossvein ...(p. 51) *Mauromyia.*
38. Third vein never bristly on more than one-fourth of the distance from base to small crossvein, sides of face destitute of macrochætæ ..... 39.
Third vein bristly at least three-fourths of distance from base to the small crossvein, sides of face bearing macrochætæ ..... (p. 52) *Ceratomyiella.*
39. Face in profile strongly convex, orbital bristles usually present in both sexes, front tarsi of female generally dilated ..... (p. 53) *Admontia.*
Face in profile concave, orbital bristles wanting in the male, front tarsi slender in both sexes ..... (p. 52) *Cryptomeigenia.*
40. Eyes bare, or with indistinct short sparse hairs ..... 49.
Eyes distinctly hairy ..... 41.
41. Sides of face bearing stout macrochætæ, at least near lower end of each eye .. 45.
Sides of face destitute of macrochætæ ..... 42.

42. Macrochætæ of second segment of abdomen covering more than its apical half. 44.
Macrochætæ of second segment, when present, confined to the apical fifth of this segment ..... 43.

43. Cheeks over one-third as broad as the eye-height ..... (p. 50) *Myiophasia.*
Cheeks less than one-sixth as broad as the eye-height ..... (p. 124) *Winthemia.*

44. Third joint of the antennæ almost straight on the front edge, the apex subtruncated ..... (p. 145) *Bombyliomyia.*
Third joint strongly convex on the front edge, the apex rounded. (p. 147) *Jurinella.*

45. Posterior end of hind crossvein nearer to the margin of the wing than to the small crossvein ..... 46.
Posterior end of hind crossvein at least twice as far from the margin of the wing as from the small crossvein, third joint of antennæ less than three times as long as the second ..... (p. 78) *Cyrtophlæba.*

46. Facial ridges never bristly on more than the lowest fifth ..... 47.
Facial ridges bristly on at least the lower half, third joint of antennæ about three times as long as the second, apical cell open ..... (p. 136) *Gædiopsis.*

47. Last joint of antennæ at least five times as long as the second ..... 48.
Last joint scarcely longer than the second, penultimate joint of arista broader than long ..... (p. 125) *Muscopteryx.*

48. Penultimate joint of arista at least three times as long as broad, third joint of antennæ of male divided lengthwise into two parts, two pairs of orbital bristles in both sexes ..... (p. 137) *Dichocera.*
Penultimate joint at most slightly longer than broad, third joint of antennæ entire, male destitute of orbital bristles ..... (p. 126) *Paradidyma.*

49. Ocellar bristles present ..... 55.
Ocellar bristles wanting ..... 50.

50. Vibrissæ inserted near lower edge of face ..... 51.
Vibrissæ inserted near the middle of the face, cheeks broader than the eye height. (p. 138) *Microphthalma.*

51. Sides of face destitute of macrochætæ ..... 52.
Sides of the face each bearing two or three stout macrochætæ on the lower part. (p. 140) *Peleteria.*

52. Second segment of abdomen never bearing more than six marginal macrochætæ. (p. 141) *Archytas.*
Second segment of abdomen bearing at least twelve marginal macrochætæ .. 53.

53. Palpi gradually thickening from the base outwardly, proboscis shorter than height of head ..... 54.
Palpi thickened on the apical three-fourths, proboscis beyond the basal articulation at least one and one-third times as long as height of head .. (p. 146) *Dejeania.*

54. Outline of abdomen subquadrate, the apex deeply emarginate. (p. 146) *Paradejeania.*
Outline of abdomen conical, the apex not distinctly emarginate .. (p. 146) *Jurinia.*

55. The ocellar bristles directed obliquely forward ..... 57.
The ocellar bristles curving backward, very robust ..... 56.

56. Front opaque, the vitta deep brown or black ..... (p. 134) *Spallanzania.*
Front shining, largely semitranslucent yellow, the vitta light yellowish. (p. 132) *Gonia.*

57. Apical cell open, or, if closed, the petiole less than two-fifths as long as the hind crossvein ..... 58.
Apical cell closed, the petiole at least two-thirds as long as the hind crossvein. (p. 126) *Phorichæta.*

58. Last section of fifth vein less than half as long as the preceding section ..... 61.
Last section of fifth vein almost as long as the preceding section, hind crossvein nearly midway between the small and the bend of the fourth ..... 59.

59. Sides of face destitute of stout macrochætæ ..... 60.
Sides of face bearing one or more pairs of stout, downwardly curving macrochætæ below the lowest frontal bristles, arista thickened on the basal three-fourths. (p. 77) *Paraplagia.*

60. Arista thickened almost to the tip, third vein bristly nearly to the small crossvein ..... (p. 77) *Metaplagia.*
Arista never thickened to the middle, third vein bristly less than halfway to the small crossvein ..... (p. 76) *Heteropterina.*

61. Facial ridges bristly on less than the lowest fourth ..... 63.
Facial ridges bristly on at least the lower half ..... 62.

62. Penultimate joint of arista over twice as long as broad, bend of fourth vein destitute of a distinct appendage ..... (p. 137) *Chætogadia.*
Penultimate joint of arista shorter than broad, bend of fourth vein with a distinct appendage ..... (p. 127) *Araba.*

63. Antennæ reaching only slightly below middle of face ..... 64.
Antennæ reaching to or below the lowest fourth of the face ..... 72.

64. First posterior cell open ..... 65.
First posterior cell closed, the petiole as long as the small crossvein, cheeks two-thirds as broad as the eye height, facial ridges nearly parallel, sides of the face at narrowest part each as wide as the median depression. (p. 132) *Euthyprosopa.*

65. Abdomen subopaque, partly or wholly covered with pollen ..... 66.
Abdomen shining, destitute of pollen ..... (p. 50) *Myiophasia.*

66. Vibrissæ inserted at least the length of the second antennal joint above the oral margin ..... 67.
Vibrissæ inserted half the length of the second antennal joint or less above the oral margin ..... 70.

67. Frontal bristles not descending below base of antennæ ..... 68.
Frontal bristles, at least two pairs, situated below base of antennæ, vibrissæ near middle of face, cheeks broader than the eye height. (p. 138) *Microphthalma.*

68. Cheeks less than one-half as broad as the eye height, sides of face destitute of macrochætæ ..... 69.
Cheeks almost as broad as the eye height, sides of face bearing a row of macrochætæ ..... (p. 51) *Phyto.*

69. Small crossvein beyond the tip of the first vein ..... (p. 80) *Senotainia.*
Small crossvein far before the tip of the first vein ..... (p. 138) *Amobia.*

70. Third joint of antennæ at most but slightly longer than the second, sides of the face destitute of macrochætæ ..... 71.
Third joint more than twice as long as the second, antennæ two-thirds as long as the face, sides of face bearing a row of macrochætæ ..... (p. 131) *Brachycoma.*

71. Second joint of arista over twice as long as broad ..... (p. 143) *Echinomyia.*
Second joint at most only slightly longer than broad ..... (p. 138) *Amobia.*

72. Face bearing macrochætæ at least near lower ends of the eyes ..... 73.
Face destitute of macrochætæ on its sides ..... 76.

73. Head at the vibrissæ as long as at base of antennæ, third joint of antennæ less than twice as long as the second ..... 74.
Head at the vibrissæ much shorter than at base of antennæ ..... 75.

74. Hind crossvein much nearer to the bend of the fourth vein than to the small crossvein ..... (p. 131) *Brachycoma.*
Hind crossvein at most only slightly nearer to the bend than to the small crossvein ..... (p. 130) *Tricogena.*

75. Facial ridges almost parallel, sides of face at narrowest part each nearly as wide as the median depression ..... (p. 128) *Opsidia.*
Facial ridges widely diverging below, sides of face each less than one-half as wide as the median depression ..... (p. 127) *Metopia.*

76. Last joint of antennæ at least twice as long as the second ..... 77.
Last joint at most only slightly longer than the second.....(p. 143) *Echinomyia.*

77. Second segment of abdomen bearing at most only two marginal macrochætæ, hind tibiæ not ciliate ..... 78.
Second segment bearing at least four marginal macrochætæ, hind tibiæ outwardly densely ciliate with flattened setæ.....(p. 123) *Blepharipeza.*

78. Diameter of the head at the vibrissæ much shorter than at base of antennæ, third joint of the antennæ at least two and one-half times as long as the second. (p. 128) *Hilarella.*
Diameter of head at the vibrissæ as long as at base of antennæ, third joint of antennæ less than twice as long as the second.....(p. 131) *Brachycoma.*

79. Proboscis beyond the basal articulation at most one and one-fifth times as long as height of head ..... 84.
Proboscis beyond the basal articulation at least one and one-third times as long as height of head, eyes bare ..... 80.

80. Apical cell ending at or close to the extreme tip of wing ..... 82.
Apical cell ending far before the extreme tip of wing, proboscis geniculate near the base only ..... 81.

81. Ridges of face bristly on at least the lower three-fourths, apical cell closed, the petiole longer than the small crossvein .....(p. 79) *Chætoglossa.*
Ridges of face never bristly on more than the lowest fifth, apical cell open. (p. 85) *Aphria.*

82. With only one geniculation in the proboscis, situated near its base..... 83.
With two geniculations, one near the base and the other near the middle, facial ridges never bristly on more than the lowest fourth.....(p. 75) *Siphona.*

83. Facial ridges bristly on at least the lower half.....(p. 73) *Isoglossa.*
Facial ridges never bristly on more than the lowest fifth .....(p. 74) *Epigrimyia.*

84. Abdomen bright green or bluish green, facial ridges never bristly on more than the lowest fourth, eyes hairy .....(p. 89) *Gymnochæta.*
Abdomen black or more or less yellowish.
Apical cell ending far before the extreme tip of wing..... 85.
Apical cell ending at or close to the extreme tip of wing ..... 129.

85. Last section of fifth vein less than one-half as long as the preceding section.. 87.
Last section of fifth vein almost as long as the preceding section, bend of fourth vein with a long appendage, eyes bare or with indistinct, short, sparse hairs, ocellar bristles directed obliquely forward ..... 86.

86. Bristles of facial ridges confined to their lowest third.....(p. 76) *Heteropterina.*
Bristles ascending at least to upper third of the ridges..(p. 77) *Plagiprospherysa.*

87. Ocellar bristles when present directed obliquely forward..... 89.
Ocellar bristles curving backward, apical cell closed and petiolate..... 88.

88. Penultimate joint of arista over four times as long as broad, facial ridges bristly on more than the lower half.....(p. 79) *Distichona.*
Penultimate joint shorter than broad, facial ridges never bristly on more than the lowest fifth.....(p. 68) *Leucostoma.*

89. Eyes bare, or with indistinct, short, sparse hairs..... 99.
Eyes distinctly hairy..... 90.

90. Second segment of abdomen bearing at most only three pairs of macrochætæ in the middle of the dorsum..... 91.
Second segment thickly covered with macrochætæ on at least two-thirds of its length .....(p. 145) *Bombyliomyia.*

91. Facial ridges never bristly on more than the lower half..... 94.
Facial ridges bristly on at least their lower two-thirds ..... 92.

92. Front destitute of backwardly curving macrochætæ outside of the two frontal rows ..... 93.
Front in each sex bearing two or three pairs of backwardly curving macrochætæ outside of the regular frontal rows ..... (p. 116) *Pseudochæta.*
93. Bend of fourth vein bearing a long appendage or distinct fold. (p. 101) *Euphorocera.*
Bend of fourth vein destitute of an appendage or fold..... (p. 102) *Phorocera.*
94. Sides of face at narrowest part less than one-third as wide as the median depression..... 96.
Sides of face more than one-half as wide as the median depression..... 95.
95. Head at the vibrissæ much shorter than at base of antennæ, bend of fourth vein destitute of an appendage..... (p. 89) *Macromeigenia.*
Head at the vibrissæ as long as at base of antennæ, bend of fourth vein bearing an appendage..... (p. 89) *Metaphyto.*
96. Diameter of head at the vibrissæ much shorter than at base of antennæ, bend of fourth vein destitute of an appendage..... 97.
Diameter of head at the vibrissæ as long as at base of antennæ..... 98.
97. Frontal bristles descending at least to last third of the second antennal joint. (p. 91) *Exorista.*
Frontal bristle not descending below the base of the second antennal joint. (p. 61) *Macquartia.*
98. Base of fourth vein bearing a long appendage; second and third segments of the abdomen destitute of discal macrochætæ..... (p. 87) *Nemoræa.*
Bend of fourth vein at most with an extremely short appendage, second and third segments of abdomen bearing discal macrochætæ..... (p. 88) *Panzeria.*
99. Antennæ reaching at least the lowest fourth of the face..... 110.
Antennæ not reaching below the lowest third of the face..... 100.
100. Vibrissæ at less than one-half the length of the second antennal joint above the level of the front edge of the oral margin..... 108.
Vibrissæ inserted at least the length of the second antennal joint above the level of the front edge of the oral margin..... 101.
101. Lowest frontal bristles below middle of the second antennal joint..... 105.
Lowest frontals not below base of the second antennal joint..... 102.
102. Cheeks less than one-third as broad as the eye height, arista never thickened on more than the basal third..... 103.
Cheeks almost as broad as the eye height, arista thickened nearly to the tip, abdomen shining, not pollinose..... (p. 85) *Melanophrys.*
103. Frontal bristles in two rows..... 104.
Frontal bristles in four rows..... (p. 79) *Pachyophthalmus.*
104. Diameter of head at the vibrissæ as long as at base of antennæ, lower front angle of the third antennal joint not prolonged in the form of a tooth. (p. 80) *Senotainia.*
Diameter of head at the vibrissæ much shorter than at base of antennæ, lower front angle of the third antennal joint prolonged into a sharp tooth. (p. 115) *Accmyia.*
105. Ocellar bristles present, directed obliquely forward..... 106.
Ocellar bristles wanting..... (p. 81) *Belvosia.*
106. Hind tibiæ not distinctly ciliate outwardly..... 107.
Hind tibiæ outwardly ciliate with bristles, apical cell open..... (p. 83) *Atacta.*
107. Apical cell open..... (p. 81) *Biomyia.*
Apical cell closed and short petiolate..... (p. 81) *Pseudotractocera.*
108. Pair of lowest frontal bristles not below base of second antennal joint..... 109.
Pair of lowest frontals below middle of second antennal joint, frontal bristles in two rows..... (p. 83) *Atacta.*
109. Frontal bristles in four rows..... (p. 79) *Pachyophthalmus.*
Frontals in two rows..... (p. 122) *Paraphyto.*

110. Vibrissæ at most only one-half the length of the second antennal joint above the level of the front edge of the oral margin ..... 113.
Vibrissæ at least the length of the second antennal joint above the level of the oral margin, frontal bristles descending below middle of the second antennal joint ..... 111.
111. The ocellar bristles present, directed obliquely forward, facial ridges never bristly on more than the lowest fourth ..... 112.
The ocellar bristles wanting, facial ridges bristly on at least the lowest third. (p. 84) *Belvosia.*
112. Outer side of hind tibiæ distinctly ciliate with bristles ..... (p. 83) *Atacta.*
Outer side of hind tibiæ not ciliate ..... (p. 81) *Biomyia.*
113. Lowest frontal bristles below the base, and usually beneath the middle, of second antennal joint ..... 116.
Lowest frontals not below base of second antennal joint ..... 114.
114. Facial depression destitute of a median carina ..... 115.
Facial depression with a high median carina, apical cell closed, the petiole twice as long as the small crossvein ..... (p. 120) *Euthera.*
115. Cheeks about as broad as the eye-height ..... (p. 85) *Melanophrys.*
Cheeks less than one-half as broad as the eye height.
Lower front corner of the third antennal joint produced in the form of a sharp tooth ..... (p. 115) *Acemyia.*
Lower front corner of the third antennal joint not produced in the form of a tooth.
Head, viewed from in front, broader than high, arista bare, or nearly so ..... (p. 128) *Hilarella.*
Head higher than broad, arista short haired ... (p. 117) *Vanderwulpia.*
116. Second segment of abdomen never bearing more than four marginal macrochætæ ..... 117.
Second segment bearing at least six marginal macrochætæ, hind tibiæ outwardly ciliate with bristles ..... (p. 123) *Blepharipeza.*
117. Hind tibiæ outwardly ciliate with bristles ..... 118.
Hind tibiæ not ciliate ..... 123.
118. Bristles of cheeks covering at least the lower three-fourths ..... 119.
Bristles of cheeks covering less than the lower half ... (p. 91) *Hyphantrophaga.*
119. Facial ridges bristly at least almost to the middle ..... 121.
Facial ridges bristly on less than the lowest fourth ..... 120.
120. Head at the vibrissæ as long as at the base of antennæ, proboscis slender, rigid, the labella horny and not thicker than the proboscis ... (p. 83) *Siphosturmia.*
Head at the vibrissæ much shorter than at base of antennæ, proboscis robust, fleshy, the labella soft ..... (p. 108) *Sturmia.*
121. With at least three backwardly curving bristles in each of the frontal rows, abdomen largely or wholly opaque pollinose ..... 122.
With only two backwardly curving bristles in each of the frontal rows, abdomen shining, destitute of pollen ..... (p. 123) *Parachæta.*
122. Front bearing two or three pairs of backwardly curving macrochætæ outside of the frontal rows, the anterior pair midway between the lowest ocellus and base of antennæ ..... (p. 116) *Pseudochæta.*
Front destitute of such macrochætæ ..... (p. 105) *Frontina.*
123. Ocellar bristles present, directed obliquely forward ..... 124.
Ocellar bristles wanting ..... (p. 84) *Belvosia.*
124. Bend of fourth vein destitute of an appendage ..... 126.
Bend of fourth vein bearing an appendage or distinct fold ..... 125.
125. Arista distinctly pubescent, facial ridges bristly on the lower five-sixth. (p. 117) *Prosphærysa.*
Arista bare, facial ridges at most bristly on the lower three-fifths. (p. 118) *Tachina.*
126. Diameter of head at the vibrissæ as long as at base of antennæ ..... 127.
Diameter of head at the vibrissæ much shorter than at base of antennæ ... 128.

127. Ridges of face bristly on at least the lower two-thirds.....(p. 120) *Tachinopsis.*
Ridges bristly on less than the lowest third.....(p. 120) *Demoticus.*
128. Lower front corner of the third antennal joint produced in the form of a sharp tooth.....(p. 115) *Acemyia.*
Lower front corner of the third antennal joint not produced in a tooth.
Vibrissæ on a level with the front edge of the oral margin..(p. 113) *Masicera.*
Vibrissæ far above the level of front edge of oral margin..(p. 81) *Biomyia.*
129. Eyes bare or with indistinct short, sparse hairs..... 133.
Eyes distinctly hairy, antennæ reaching at least to lowest fourth of the face..... 130.
130. Frontal bristles not descending below base of second antennal joint; abdomen largely or wholly opaque gray pollinose..... 131.
Frontal bristles descending below middle of second antennal joint..... 132.
131. Cheeks nearly as broad as the eye height.....(p. 64) *Hyalurgus.*
Cheeks less than one-third as broad as the eye height.....(p. 64) *Macquartia.*
132. Body shining, destitute of pollen.....(p. 64) *Polidea.*
Body partly or wholly opaque pollinose.....(p. 63) *Didyma.*
133. Frontal vitta opaque, abdomen of four segments besides the very short basal one..... 134.
Frontal vitta shining black, abdomen of only three segments besides the very short basal one.....(p. 73) *Hemyda.*
134. Apical cell open, or with a petiole less than one-half as long as the hind crossvein..... 137.
Apical cell closed, the petiole almost as long as the hind crossvein..... 135.
135. Abdomen subcylindrical, nearly twice as long as wide, the second and third segments destitute of discal macrochætæ..... 136.
Abdomen subhemispherical, only slightly longer than broad, the second and third segments bearing discal macrochætæ.....(p. 70) *Hyalomyodes.*
136. The ocellar bristles curving backward, small crossvein before the tip of the first vein.....(p. 68) *Leucostoma.*
The ocellar bristles directed obliquely forward, small crossvein far beyond the tip of the first vein.....(p. 69) *Sciasma.*
137. Palpi subcylindrical, less than one-half as wide as the proboscis..... 138.
Palpi flattened and unusually dilated, wider than the proboscis, penultimate joint of arista almost one-half as long as the last one.....(p. 57) *Lispidea.*
138. Penultimate joint of arista over twice as long as broad..... 139.
Penultimate joint of arista at most only slightly longer than broad..... 142.
139. Third vein at most bearing four bristles near its base..... 140.
Third vein bristly almost to the small crossvein.....(p. 57) *Thryptocera.*
140. Arista slender on apical half of the last joint, third antennal joint entire in both sexes..... 141.
Arista thickened to the apex, third antennal joint in the male divided lengthwise into two parts.....(p. 55) *Schizotachina.*
141. Hind crossvein nearer to bend of fourth vein than to the small..(p. 55) *Medina.*
Hind crossvein nearer to the small than to bend of fourth vein..(p. 55) *Clausicella.*
142. Sides of face at narrowest part at most one-third as wide as the median depression, fourth vein entire..... 143.
Sides of face one-half as wide as the median depression, fourth vein obliterated beyond the bend.....(p. 66) *Racodineura.*
143. Head at the vibrissæ noticeably shorter than at base of antennæ..... 144.
Head at the vibrissæ as long as at base of antennæ..... 149.
144. Horizontal diameter of the occiput above the neck less than one-half as long as that of the eye..... 145.
Horizontal diameter of occiput above the neck as long as that of the eye, antennæ reaching at least to lowest fifth of the face, vibrissæ on a level with front edge of the oral margin.....(p. 65) *Pelatachina.*

145. With one or more pairs of frontal bristles below base of the second antennal joint ..... 147.
Without any frontals below base of second antennal joint..... 146.
146. Occiput at most only slightly convex, body short and robust. (p. 70) *Estrophasia.*
Occiput strongly convex, body elongate and slender.....(p. 72) *Eutrixa.*
147. Front of male destitute of orbital bristles, venter of abdomen of female destitute of short spines, third vein bearing at least two bristles near the base.... 148.
Front in both sexes bearing orbital bristles, venter of female bearing many short black spines on the second segment, third vein usually with a single bristle near the base .....(p. 59) *Celatoria.*
148. Antennæ not reaching below the lowest fourth of the face.....(p. 81) *Biomyia.*
Antennæ almost or quite reaching the oral margin.....(p. 60) *Hypostena.*
149. Arista bare, or very short pubescent ..... 150.
Arista bearing hairs which are as long as its greatest diameter, antennæ reaching lowest fifth of the face .....(p. 66) *Leskia.*
150. Body short and robust ..... 151.
Body elongate and slender, antennæ not reaching below the lowest third of the face, apical cell closed and short petiolate.....(p. 72) *Xanthomelana.*
151. Tip of antennæ not below lowest third of the face, frontal bristles usually not descending below base of the second antennal joint ..... 152.
Tip of antennæ at or below lowest fifth of face, frontals usually descending below base of the second antennal joint..... 153.
152. Head over twice as high as long, occiput at most only slightly convex. (p. 70) *Estrophasia.*
Head about one and one-third times as high as long, occiput usually strongly convex .....(p. 71) *Clytiomyia.*
153. Third vein bearing only two or three bristles near the base, head unusually short.....(p. 70) *Estrophasia.*
Third vein bristly almost to the small crossvein, head not unusually short. (p. 75) *Siphona.*

UNRECOGNIZED GENERA.

The following genera, which have been reported from America north of Mexico, together with the species referred to them, have not been recognized by the writer, or else the species belong to other genera:

Baumhaueria analis van der Wulp, belongs to Chætogædia.

Besseria (*Wahlbergia*) *brevipennis* Loew. Nebraska.

Chrysosoma n. sp. Brauer and Bergenstamm, Zweif. Kais. Mus. Wien, V, p. 407; 1891. Georgia.

Clista americana Townsend is a synonym of *Myiophasia ænea* Wied.

Clistomorpha hyalomoides Townsend, Canadian Entomologist, Vol. XXIV, pp. 79 to 81; 1892. New York.

Cryptopalpus flaviceps Bigot, Rocky Mountains, and *melanopygatus* Bigot, Washington, Bulletin Soc. Ent. France, p. 141; 1887.

Daochæta harveyi Townsend, Trans. Amer. Ent. Soc., Vol. XIX, pp. 97 and 98; 1892. Maine.

Eliozeta americana Brauer and Bergenstamm, Zweif. Kais. Mus. Wien, V, p. 388; 1891. Georgia.

Euceromyia robertsonii Townsend, Trans. Amer. Ent. Soc., Vol. XIX, pp. 115 to 116; 1892. Southern Illinois.

Eucnephalia gonoides Townsend, Canadian Entomologist, Vol. XXIV, pp. 166, 167; 1892. New Mexico.

Eumyothyria illinoiensis Townsend, Trans. Amer. Ent. Soc., Vol. XIX, pp. 121, 122; 1892. Carlinville, Ill.

Euscopolia dakotensis Townsend, l. c., pp. 123, 124. South Dakota.
Evibrissa americana Bigot, Ann. Soc. Ent. France, p. 256; 1888. Washington.
Ginglymia acrirostris Townsend, Trans. Amer. Ent. Soc., Vol. XIX, pp. 118, 119; 1892. Constantine, Mich.
Goniochæta plagioides Townsend, l. c., Vol. XVIII, pp. 351, 352; 1891. Las Cruces, N. Mex.
Hemithrixion astriforme Brauer and Bergenstamm, Zweif. Kais. Mus. Wien, V, p. 357; 1891. Colorado.
Hesperomyia erythrocera Brauer and Bergenstamm, l. c., IV, p. 114; 1889. Texas.
Himantostoma sugens Loew. Illinois.
Hypertrophocera parvipes Townsend, Trans. Amer. Ent. Soc., Vol. XVIII, pp. 360, 361; 1891. Las Cruces, N. Mex.
Illigeria wlops Walker, belongs to Beskia; *I. corythus* Walker, is *Xanthomelana atripennis* Say; and *I. helymus* Walker, belongs to Metachæta.
Loewia nigrifrons, ruficornis, and *globosa* Townsend, appear to be synonyms of *Myiophasia ænea* Wied.
Lophosia setigera Thomson, belongs to Clausicella.
Myothyria vanderwulpia Townsend, belongs to Hypostena.
Neotractocera anomala Townsend, Trans. Am. Ent. Soc., Vol. XIX, pp. 105, 106; 1892. Las Cruces, N. Mex.
Parahypochæta heteroneura Brauer and Bergenstamm, Zweif. Kais. Mus. Wien, V, p. 337; 1891. North America.
Peteina stylata Brauer and Bergenstamm, l. c., pp. 386, 387. Greenland.
Phasia atripennis Say, belongs to Xanthomelana.
Podotachina americana Brauer and Bergenstamm, is *Tachina mella* Walker, and *P. vibrissata* of the same authors is *Euphorocera claripennis* Macquart.
Rhinophora valida and *mexicana* Townsend, Canadian Entomologist, Vol. XXIV, pp. 167, 168; 1892. Las Cruces, N. Mex.
Sarcoclista dakotensis Townsend, Trans. Am. Ent. Soc., Vol. XIX, pp. 122, 123; 1892. South Dakota.
Stevenia pictipes Bigot, is *Xanthomelana arcuata* Say.
Trixa gillettii Townsend, belongs to Paraphyto.
Tryphera americana and *polidoides* Townsend, are synonyms of *Polidea areos* Walker.
Xysta didyma Loew. Illinois.

SYSTEMATIC ARRANGEMENT OF THE GENERA.

A linear arrangement of the genera of the Tachinidæ so as to indicate their natural relationship is quite impossible, owing to the fact that in several cases each of three genera is more closely related to a fourth than to any other genus, and in a linear arrangement it is, of course, impossible to place each next to the one to which it is nearest related. The following arrangement shows the relationship of the genera given in the preceding table perhaps as nearly as can be done in a linear manner. By this arrangement, those without strong macrochætæ on the abdomen are placed at the opposite end of the series to those having these macrochætæ the most strongly developed:

Apical cell ending at or close to the extreme wingtip.
  Abdomen destitute of macrochætæ.
    Sides of the face bare.
      Proboscis shorter or only slightly longer than the head.
        Hind tibiæ not ciliate: *Cistogaster, Gymnosoma, Phorantha, Alophora.*
        Hind tibiæ outwardly ciliate: *Trichopoda.*
      Proboscis longer than the head and thorax united: *Eusiphona.*
    Sides of face with bristly hairs: *Gymnophania.*

Apical cell ending at or close to the extreme wingtip—Continued.
Abdomen bearing macrochætæ.
Sides of face with hairs or macrochætæ on the lower half: *Myiophasia, Phyto, Mauromyia, Cryptomeigenia, Ceratomyiella, Eulasiona, Admontia.*
Sides of face, on at least the lower half, bare.
Proboscis shorter or only slightly longer than height of head.
Frontal vitta opaque.
Vibrissæ on a level with the front edge of the oral margin.
Penultimate joint of arista at least twice as long as broad: *Medina, Schizotachina, Clausicella, Plectops, Lispidea, Thryptocera.*
Penultimate joint of arista shorter or only slightly longer than broad: *Actia, Lasioneura, Chætophleps, Celatoria, Hypostena, Didyma, Macquartia, Hyalurgus, Polidea, Hypochæta, Pelatachina, Racodineura, Ervia, Leskia, Leskiomima, Apinops.*
Vibrissæ distinctly above the front edge of the oral margin: *Leucostoma, Sciasma, Hyalomyodes, Estrophasia, Clytiomyia, Eutrixa, Xanthomelana.*
Frontal vitta highly polished: *Hemyda.*
Proboscis at least one-third longer than height of head: *Beskia, Isoglossa, Epigrimyia, Siphona.*
Apical cell ending some distance in front of the extreme wingtip.
Last section of the fifth vein more than one-half as long as the preceding section: *Heteropterina, Plagiprospherysa, Metaplagia, Paraplagia, Cyrtophlæba, Plagia, Siphoplagia.*
Last section of the fifth vein less than one-third as long as the preceding section.
Sides of face on the lower half bare.
Vibrissæ distinctly above the front edge of the oral margin.
Eyes bare.
Penultimate joint of arista more than twice as long as broad: *Distichona, Chætoglossa.*
Penultimate joint of arista shorter or only slightly longer than broad: *Pachyophthalmus, Senotainia, Pseudotractocera, Biomyia, Atacta, Siphosturmia, Belvosia, Melanophrys, Aphria, Ocyptera.*
Eyes distinctly hairy: *Linnæmyia, Nemoræa, Panzeria, Macromeigenia.*
Vibrissæ on a level with the front edge of the oral margin.
Eyes distinctly hairy: *Gymnochæta, Metaphyto, Exoristoides, Hyphantrophaga, Exorista, Euphorocera, Phorocera.*
Eyes bare: *Frontina, Sturmia, Masicera, Acemyia, Pseudochæta, Prospherysa, Vanderwulpia, Euthera, Houghia, Tachina, Tachinopsis, Demoticus, Paraphyto, Parachæta, Blepharipeza.*
Sides of face with hairs or macrochætæ on the lower half.
Vibrissæ on a level with the anterior edge of the oral margin: *Winthemia, Muscopteryx, Paradidyma, Atrophopalpus, Metachæta, Phorichæta, Chætoplagia, Metopia, Araba, Opsidia, Hilarella, Tricogena, Brachycoma, Euthyprosopa.*
Vibrissæ distinctly above the front edge of the oral margin.
Head at the vibrissæ much shorter than at base of antennæ: *Gonia, Spallanzania, Gædiopsis, Chætogædia, Dichocera, Microphthalma.*
Head at the vibrissæ longer than at base of antennæ: *Amobia, Trichophora, Cuphocera, Peleteria, Archytas, Echinomyia, Epalpus, Bombyliomyia, Dejeania, Paradejeania, Jurinea, Jurinella.*

The arrangement of the genera is that given above. In the case of synonyms, the oldest name has been adopted, since this method is the only one whereby a uniform system of nomenclature can be obtained. On the other hand, if we follow the law of favoritism we can never hope to have a uniform series of names, since the German student will adopt the name proposed by a German, the Frenchman one proposed by his own countryman, and so on. All of the synonymy given in these pages has been verified by the writer. By a few authors the names of certain genera have been rejected, owing to the fact that the author described under each of them species that properly belong to two or more distinct genera, but this does not at all invalidate the genus, since the name may be retained for one or more of the species and new generic terms applied to the others. Again, certain genera have been rejected on the score that they have been insufficiently characterized, but if one of the species that the author placed in a given genus can be identified with reasonable certainty, the generic characters can readily be ascertained from an examination of the specimens themselves.

Genera founded on characters peculiar to one sex only have not been adopted. The writer is of the opinion that in case the females of any two given species are structurally identical, these two species should not be separated into different genera, no matter to what extent the males of these two species may differ from each other. Any classification that will not enable us to refer a single specimen of either sex to its correct genus must necessarily come short of the very object for which it was designed.

The following pages contain references to all the species of Tachinidæ hitherto reported as occurring in this country north of Mexico and belonging to genera of which the writer has examined representatives. Only the species studied by the writer are tabulated; the others are listed at the end of the tables. Genera of which the writer has seen no representatives, together with the species from this region referred to them, have already been listed on previous pages. The localities given are those in which the specimens studied were captured; the published records have not been added, since it was intended to make the present work as nearly original as possible. The color of the halteres has been purposely omitted as of no specific importance.

Types of all the new species have been deposited in the United States National Museum.

Genus CISTOGASTER Latr.

Cistogaster Latreille, in Cuvier's Regne animal, Vol. V; 1829.
Pallasia Desvoidy, Essai sur les Myodaires, p. 239; 1830.
Gymnoclytia Brauer and Bergenstamm, Zweif. Kais. Mus. Wien, VI, p. 157; 1893.

The synonymy of Pallasia and Cistogaster was first pointed out by Macquart, and has been confirmed by Rondani, Schiner, Brauer and Bergenstamm, and others. Our single species is very different in the

opposite sexes; in the female the abdomen is black, while in the male it is largely or wholly yellow; in the female the thorax is gray pollinose, marked with two black vittæ; in the male it is yellowish pollinose, marked with four black vittæ; length, 5 to 7 mm. Grimsby, Canada; Maine; Franconia and White Mountains, New Hampshire; District of Columbia; North Carolina: Tifton, Ga.; Texas, Colorado, and California. (Diptères Exotiques, Vol. II, Part III, p. 233(76); 1812. *Gymnosoma occidua* Walker, List Dipt. Insects, Part IV, p. 692; 1849. *Cistogaster divisa* Loew, Diptera Amer. Sept. Indig., Centuria IV, No. 88; 1863. *Gymnoclytia divisa* Brauer and Bergenstamm *in litt.*) . . *immaculata* Macq.

Genus GYMNOSOMA Meig.

Gymnosoma Meigen, in Illiger's Magazin für Insektenkunde, Vol. II, p. 278; 1803.

In our single species the abdomen is yellow and marked with a black dorsal vitta or row of spots; dorsum of thorax of male in front of the suture yellowish pollinose and marked with four black vittæ, but in the female the dorsum is destitute of pollen except the humeri and narrow lateral margins; length, 5 to 8 mm. Grimsby, Canada; White Mountains and Franconia, N. H.; Maryland; District of Columbia; Virginia; Michigan; Agricultural College, Miss.; New Orleans, La.; Missouri; Kansas; Green River City, Wyo.; Colorado, Idaho, and California. (Essai sur les Myodaires, p. 237; 1830. *Gymnosoma par* Walker, List of Dipterous Insects, Part IV, p. 692; 1849. *Gymnosoma filiola* Loew, Dipt. Amer. Sept. Indigena, Centuria X, No. 66; 1872. *Gymnosoma* sp., Brauer and Bergenstamm *in litt.*) . . . . *fuliginosa* Desv.

Genus PHORANTHA Rond.

Phorantha Rondani, Dipterologiæ Italicæ Prodromus, Vol. V, p. 21; 1862.

Our species are black, the palpi and apex of proboscis sometimes yellow; only one postsutural and one sternopleural macrochæta; wings not marked with brown beyond the base of the discal cell, costa nearly straight:

1. Thorax subshining, almost destitute of pollen, not marked with distinct black vittæ; last section of the third vein nearly one half as long as the preceding section . . . . . 2.

   Thorax opaque, densely gray pollinose, marked with four shining black vittæ; frontal vitta of female at the narrowest point slightly wider than the distance between the posterior ocelli, last section of the third vein one-fourth as long as the preceding section, calypteres white; length 7 mm. Los Angeles County, Cal. (Tijdsch. voor Entomologie, Vol. XXXV, p. 185; 1892: *Hyalomyia.*) . . . . . *nigrens* v. d. W.

2. Calypteres whitish, second and third segments of abdomen thinly whitish pollinose, frontal vitta of female at the narrowest point less than one-third as wide as the distance between the posterior ocelli; length, 2.5 to 5 mm. Fort McLeod, British America; Maryland; southern Illinois; Georgia; Nueces, Tex.; South Dakota;

Canon City, Colo.; Las Cruces, N. Mex.; Washington; Los Angeles and San Diego counties, Cal.; and Allende, Mexico. (Insecta Saundersiana, Vol. I, p. 260; 1856: *Hyalomyia. Alophora luctuosa* Bigot, Annales Soc. Entomol. France, p. 255; 1888. *Hyalomyia punctigera* Townsend, Proc. Ent. Soc. Washington, Vol. II, p. 135; April 2, 1891. *Hyalomyia aldrichii* Townsend, l. c., p. 136; from a cotype specimen. *Hyalomyia robertsonii* Townsend, l. c. *Hyalomyia purpurascens* Townsend, l. c., p. 137; from a cotype specimen. *Hyalomyia celer* Townsend, Trans. Amer. Ent. Soc., Vol. XXII, p. 65; March, 1895. *Hyalomyia violascens* Townsend, Annals Mag. Nat. Hist., Vol. XX, p. 32; July, 1897. *Phorantha* sp., Brauer and Bergenstamm *in litt.*) ..... *occidentis* Walk.

Calypteres brown, first three segments of abdomen not distinctly pollinose except along the sides, the fourth segment lightly whitish pollinose and dotted with black, frontal vitta of male obliterated on its upper part, wings with a strong whitish tinge; length, 3.5 to 4 mm. District of Columbia; Potomac Creek, Virginia; Lexington, Ky.; and northern Illinois. Nine males, one taken by the writer in July, another captured by Mr. C. W. Johnson, May 23, 1896, a third by Dr. W. A. Nason, August 16, 1895, and six captured by Prof. H. Garman. Type No. 3518, U. S. National Museum ..... *calyptrata* n. sp.

Genus ALOPHORA Desv.

Alophora Desvoidy, Essai sur les Myodaires, p. 293; 1830.
Hyalomyia Desvoidy, loc. cit., p. 298.

Schiner[1] has already referred these two divisions as subgenera of the first-mentioned genus, and in this he is followed by Brauer and Bergenstamm.[2] Of the ten species occurring in our fauna, the females of only four are known to me:

1. Wings distinctly marked with brown beyond base of discal cell outside of the costal cell (all males) ..... 6.
   Wings wholly hyaline beyond base of discal cell except sometimes in the costal cell ..... 2.
2. Second and third abdominal segments shining or subshining .... 3.
   Second and following segments opaque, densely yellow gray pollinose; thorax, when viewed from behind, thinly white pollinose along the suture, in front of the scutellum, and along the sides; eyes contiguous; black, the palpi yellow, calypteres white, wings whitish hyaline, costa strongly arcuate, last section of third vein slightly less than one-third as long as the preceding section; length, 5 mm. Eastern Washington. A single male specimen collected by Professor Piper. Type No. 3519, U. S. National Museum ..... *opaca* n. sp.

[1] Fauna Austriaca, Vol. I, p. 402; 1862.
[2] Zweif. Kais. Mus. Wien, IV, p. 149; 1889. Also loc. cit., VI, p. 157; 1893.

3. Females; genitalia awl-shaped, directed backward ..... 4.
Males; genitalia tubular, directed forward under the body; black, the palpi yellow, abdomen with a pronounced brassy tinge, shining, thinly white pollinose; thorax when viewed from behind thinly white pollinose except the front end and two subdorsal vittæ behind the suture; eyes separated as widely as the posterior ocelli, calypteres grayish white, wings whitish hyaline, base to tip of second basal cell yellow, costa strongly arcuate, last section of third vein nearly half as long as the preceding section; length, 6 mm. Potomac Creek, Virginia. A single male specimen collected May 23, 1896, by C. W. Johnson. Type No. 3520, U. S. National Museum ..... *nitida* n. sp.

4. Frontal vitta at narrowest part less than one-third as wide as the distance between the posterior ocelli ..... 5.
Frontal vitta at narrowest part as wide as the distance between the posterior ocelli; last section of third vein slightly over one-third as long as the preceding section; length, 4 to 6 mm. White Mountains and Franconia, N. H., and Potomac Creek, Virginia. (Trans. Amer. Ent. Soc., Vol. XIII, p. 296; October, 1886: *Hyalomyia.*) ..... *æneoventris* Will.

5. Last section of third vein over one-third as long as the preceding section, small crossvein nearer to tip of first vein than to tip of the auxiliary, or midway between them; black, the palpi yellow; thorax, when viewed from behind, subopaque whitish pollinose, with indistinct black vittæ; eyes separated slightly wider than width of lowest ocellus; face white or gray pollinose; abdomen on the last three segments whitish pollinose, the second and third segments with a black dorsal vitta; calypteres whitish or yellowish; wings hyaline, the base to slightly beyond the humeral crossvein yellowish; length, 9 mm. Beverly, Mass. A female specimen collected October 11, 1870, by the late Edw. Burgess. Type No. 3521, U. S. National Museum .. *diversa* n. sp.
Last section, etc., as above; vitta of abdomen indistinct; length, 5 mm. Two females, one captured at Sherbrooke, Canada, September 25, 1896, by L'Abbé P. A. Begin, the other taken with the male (see above under 3) ..... *nitida* n. sp.
Last section of third vein less than one-sixth as long as the preceding section, small crossvein nearer to tip of auxiliary vein than to tip of first vein; eyes separated about half the width of the lowest ocellus; face yellow pollinose, abdomen wholly thinly whitish pollinose; length, 9 to 10 mm.; otherwise as in *diversa*. Lufkin, Tex. (October 17, 1894; C. W. Johnson), and southern Illinois (Charles Robertson). Two female specimens. Type No. 3522, U. S. National Museum ..... *grandis* n. sp.

6. Thorax destitute of a large spot of yellowish pollen in front of the scutellum ..... 7.

Thorax bearing a large spot of yellowish pollen, elsewhere subopaque, the sides and suture gray pollinose; abdomen shining bluish black, the margin sometimes yellow, on the fourth segment grayish pollinose; wings hyaline, brownish costally except at base, the brown color extending to middle of discal cell, sometimes forming a border to the fifth vein and the hind crossvein, and containing hyaline spaces; length, 6 to 7 mm. White Mountains and Franconia, N. H. (Annales Soc. Entomol. France, p. 255; 1888. *Hyalomyia* sp., Brauer and Bergenstamm *in litt.*) ..... *fenestrata* Bigot.

7. Wings destitute of a distinct hyaline spot beyond tip of first vein. 8.

Wings marked with such a spot reaching from near the costa to middle of first posterior cell, elsewhere brown, with hyaline spaces and hind margin; costa excessively arcuate, first posterior cell over half as wide as long; black, the palpi yellow, abdomen shining brassy black, thinly whitish pollinose, thorax, when viewed from behind, subopaque, thinly whitish pollinose, two subdorsal vittæ, the front end, and behind the suture black; calypteres white; frontal vitta at narrowest part two-thirds as wide as distance between the posterior ocelli; length, 8 mm. Franconia, N. H. A male specimen, collected by Mrs. A. T. Slosson. Type No. 3523, U. S. National Museum. . *phasioides* n. sp.

8. Abdomen more or less shining ..... 10.

Abdomen opaque, yellowish gray pollinose ..... 9.

9. Veins on front and hind edges of discal cell bordered with brown; black, the palpi yellow; thorax, when viewed from behind, thinly whitish pollinose, the front end, behind the suture, and two subdorsal vittæ black; frontal vitta at narrowest part half as wide as distance between the posterior ocelli; calypteres whitish; wings brown, the base yellowish, the hind margin and centers of discal and first posterior cells usually hyaline, costa rather strongly arcuate; length, 4.5 to 6 mm. Clementon, N. J. (May 10 and 26, 1896), and Potomac Creek, Va. (May 23, 1896). Six male specimens, collected by C. W. Johnson. Type No. 3524, U. S. National Museum ..... *fumosa* n. sp.

Veins on front and hind edges of discal cell not bordered with brown, wings whitish hyaline, the base to beyond the humeral crossvein yellowish, costal margin beyond this to slightly below apex of third vein, last two sections of third vein, and fourth vein beyond the bend bordered with smoky brown, costa excessively arcuated; length, 7 mm.; otherwise as in the above description of *fumosa*. Grimsby, Canada. A single male specimen, collected October 7, 1894. Type No. 3525, U. S. National Museum ..... *pulverea*, n. sp.

10. Length, 6 mm. or less; last section of third vein over one-third as long as the preceding section ..... 11.
Length, 8 to 10 mm ..... 12.

11. Abdomen shining brassy black, the margins whitish pollinose, wings hyaline, the base and a large spot on middle extending from costa to fifth vein smoky. (See above under 4.)
æneoventris Will.

Abdomen subopaque whitish pollinose, the first segment, a dorsal vitta on the others, and the hind margins of the second and third black; black, the palpi yellow; thorax, when viewed from behind, subopaque, traces of a yellowish pollinose spot in front of the scutellum; eyes separated slightly wider than width of lowest ocellus, wings smoky, the hind margin subhyaline; calypteres yellowish; length, 6 mm. Woodbury, N. J. A single male specimen, collected June 7, 1896, by C. W. Johnson. Type No. 3526, U. S. National Museum..... *subopaca* n. sp.

12. Last section of third vein less than one-sixth as long as the preceding section, small crossvein nearer to tip of auxiliary vein than to tip of first vein, eyes separated less than width of lowest ocellus, wings from base almost to small crossvein dusky yellowish, the remainder brown, calypteres brown, the margin, the lower edge of the front one broadly, and of the hind one at its base white; otherwise as in the female (under 5 above). Lufkin, Tex., October 17, 1896. A single male specimen, collected by C. W. Johnson..... *grandis* n. sp.

Last section of third vein over one-fourth as long as the preceding section, small crossvein not nearer to tip of auxiliary vein than to tip of first vein, eyes separated one and one-half times width of lowest ocellus, abdomen with a strong brassy or violaceous tinge, wings from base to beyond base of discal cell yellowish, the remainder brown, the hind margin subhyaline; otherwise as in the female (under 5 above). Beverly, Mass. (October 11, 1870, Edw. Burgess); Oswego, N. Y. (October 4, 1895, C. W. Johnson), and Indiana. Three male specimens.. *diversa* n. sp.

Genus TRICHOPODA Latr.

Trichopoda Latreille, in Cuvier's Regne animal, Vol. V; 1829.

Our species have one postsutural and two sternopleural macrochetæ, apical cell short petiolate:

1. Abdomen partly or wholly yellowish..... 2.

Abdomen and legs wholly black, the former not pollinose; wings black, not marked with white or yellow, the hind margin subhyaline; lower calypteres brown, the bases white; thorax deep black, the sides, transverse suture, and two subdorsal vittæ in front of it light gray pollinose; length, 10 to 14 mm. Florida; Waco, Tex., and Colorado. (Systema Antliatorum, p. 220; 1805: *Thereva.*)..... *lanipes* Fabr.

2. Without any fasciæ of gray pollen on the abdomen, which is subshining and almost or wholly destitute of pollen ..... 3.

With an opaque, interrupted fascia of yellowish pollen on the second, third, and fourth segments of the abdomen; scutellum and femora yellow, thorax shining black, the portion in front of the transverse suture yellowish pollinose and marked with three or four black vittæ; wings brown, the costal margin more or less yellow, the hind margin broadly hyaline; lower calypteres yellowish; length, 7 to 11 mm. District of Columbia; Texas, and Napa County, Cal. (Systema Antliatorum, p. 220; 1805: *Thereva. Trichopoda histrio* Walker, List of Dipterous Insects, Part IV, p. 697; 1849. *Trichopoda trifasciata* Loew, Dipt. Amer. Sept. Indigena, Centuria IV, No. 90; 1863: also Brauer and Bergenstamm *in litt.*) ..... *plumipes* Fabr.

3. Lower calypteres wholly yellowish; abdomen bright yellow, the apex sometimes black; legs black, bases of femora sometimes yellow, hind margin of wings subhyaline ..... 4.

Lower calypteres brown, the bases white; abdomen yellowish brown, the fifth segment yellow, legs black, the bases of the middle and hind femora sometimes yellow; wings brown, a white vitta along each of the first five veins, hind margin subhyaline; length 14 to 17 mm. District of Columbia; Waco, Tex., and Tehuantepec, Mexico. (Aussereuropäische Zweif. Insekten, Vol. II, p. 268; 1830. *Trichopoda radiata* Loew, Dipt. Amer. Sept. Indigena, Centuria IV, No. 89; 1863: also Brauer and Bergenstamm *in litt.*) ..... *formosa* Wied.

4. Penultimate section of fourth vein of male bordered in front with whitish, the first five veins usually partly bordered with white, a yellowish spot on front part of each wing of the male; length, 9 to 14 mm. West Roxbury, Mass.; District of Columbia; Virginia; Tifton, Ga.; Biscayne Bay, Florida; Cadet, Mo.; Douglas County, Kans., and Texas. (Aussereuropäische Zweif. Insekten, Vol. II, p. 276; 1830. *Therera pennipes* Fabricius, Systema Antliat., p. 219; 1805: *non Musca pennipes* Fabricius; 1794. *Trichopoda aurantiaca* Townsend, Proc. Ent. Soc. Washington, Vol. II, p. 140; April 2, 1891.) ..... *cilipes* Wied.

Penultimate section of fourth vein not bordered with whitish in either sex, any of the veins rarely bordered with whitish; wings of male usually but not always marked in front with a yellow spot; length, 7 to 12 mm. Grimsby, Canada; Belmont, Mass.; Philadelphia, Pa.; District of Columbia; North Carolina; Florida; Mississippi; Lexington, Ky.; Missouri; Onaga, Kans.; Colorado; Los Angeles County, Cal., and Mexico. (Entomologia Systematica, Vol. IV, p. 348; 1794: *Musca. Therera hirtipes* Fabricius, Systema Antliat., p. 219; 1805. *Ocyptera ciliata* Fabricius, loc. cit., p. 315. *Phasia jugatoria* Say, Jour. Acad. Nat.

Sci. Philadelphia, Vol. VI, p. 172; 1829. *Trichopoda flavicornis* Desvoidy, Essai sur les Myodaires, p. 284; 1830. *Trichopoda pyrrhogaster* Wiedemann, Aussereur. Zweif. Ins., Vol. II, p. 272; 1830: also Brauer and Bergenstamm *in litt.*).....*pennipes* Fabr.

Genus EUSIPHONA, new genus.

The principal characters of this genus may be gathered from the following description of the type species: Front of female nearly one-half as wide as either eye, ocellar bristles directed obliquely forward, frontal bristles weak, disposed in four rows, not descending beneath base of antennæ, front, including the vitta, gray pollinose; sides of face bare, gray pollinose, each at narrowest point about one-seventh as wide as the median depression, the latter with a distinct median carina; vibrissæ short, inserted below the level of the anterior portion of the oral margin; facial ridges bare, nearly parallel and only slightly approaching each other at the vibrissæ; cheeks extremely narrow, scarcely apparent; proboscis bristle-like, longer than the entire insect, geniculate in the middle, the apical half folding beneath the basal half; labella absent, palpi clavate, reaching about halfway to the anterior oral margin; antennæ four-fifths as long as the face, the third joint nearly three times as long as the second, suborbicular; arista bare, thickened on the basal third, the penultimate joint shorter than broad; eyes bare; thorax lightly gray pollinose, anterior half of middle of dorsum destitute of macrochætæ, two postsutural and two sternopleural macrochætæ, the latter near the posterior end of the sternopleura, no other macrochætæ on the pleura; scutellum subtriangular, bearing four marginal macrochætæ; abdomen and legs destitute of macrochætæ and of pollen; wings hyaline, veins bare, apical cell open at the extreme wing tip, last section of fourth vein gradually approaching the third, small crossvein near last third of discal cell, auxiliary vein lying close to the first and almost united with it at the apex. Color, black; the second antennal joint, spot at insertion of antennæ, and the anterior oral margin yellow; calypteres small, white; length, 5 mm. Indiana and Colorado. Two female specimens. Type No. 3526, U. S. National Museum.....*mira* n. sp.

Genus GYMNOPHANIA Br. and Berg.

Gymnophania Brauer and Bergenstamm, Zweif. Kais. Mus. Wien, IV, p. 143; 1889.

Our single species is black, the antennæ and legs tinged with brown; front in male slightly narrower than width of the lowest ocellus, antennæ four-fifths as long as the face, the third joint slightly shorter than the second, cheeks one-seventh as broad as the eye height; body shining, not pollinose, only one postsutural and one sternopleural macrochæta, scutellum bearing two marginal pairs, abdomen and legs destitute of macrochætæ; wings hyaline, the costal margin beyond tip

of auxiliary vein slightly smoky as far as the fourth vein, last sections of third and fourth veins gradually converging, ending a short distance from each other at the extreme wing tip, small crossvein at last fourth of discal cell; calypteres white; length, 4 mm. White Mountains, New Hampshire. Five male specimens, one collected by Mrs. A. T. Slosson and the others by the late H. K. Morrison. (*Gymnophania* sp., Brauer and Bergenstamm *in litt.*) Type No. 3528, U. S. National Museum ..... *montana* n. sp.

Genus MYIOPHASIA Br. and Berg.

Myiophasia Brauer and Bergenstamm, Zweif. Kais. Mus. Wien, V., p. 362; 1891.
Phasioclista Townsend, Trans. Amer. Ent. Soc., Vol. XVIII, p. 369; December, 1891.
Ennyomma Townsend, loc. cit., p. 371.

The synonymy of the first two has already been given by Brauer and Bergenstamm.[1] Our two species have three postsutural and two sternopleural macrochaetæ; eyes usually bare but sometimes hairy, especially in the male:

Third and other segments of abdomen shining, destitute of pollen; greenish black, the lower part of the head except on the occiput, also more or less of the antennæ, yellow or brown; bases of the wings yellow; length, 6 to 9 mm. White Mountains, New Hampshire; Massachusetts; South Carolina; Georgia; Charlotte Harbor, Florida; Colorado; and Santa Fe, N. Mex. (Aussereuropäische Zweif. Insekten, Vol. II, p. 298; 1830: *Tachina. Clytia atra* Desvoidy, Essai sur les Myodaires, p. 288; 1830. *Phasioclista metallica* Townsend, Trans. Amer. Ent. Soc., Vol. XVIII, p. 370; Dec., 1891. *Ennyomma clistoides* Townsend, loc. cit., p. 371. *Loewia ruficornis* Townsend, Canadian Entomologist, Vol. XXIV, p. 77; April, 1892. *Loewia nigrifrons* Townsend, loc. cit. *Clista americana* Townsend, loc. cit., p. 78. *Loewia globosa* Townsend, Entomological News, Vol. III, p. 129; June, 1892. *Myiophasia ?ænea* Wied., Brauer and Bergenstamm *in litt.*) ..... *ænea* Wied.

Third and fourth segments of abdomen, and center of the second, subopaque gray pollinose; black, the second joint of antennæ yellow, the frontal vitta and lower part of the head except the occiput brown; front of male scarcely wider than width of lowest ocellus, frontal bristles not descending below base of second antennal joint, antennæ almost reaching middle of face, the third joint only slightly longer than the second, arista thickened on its basal fourth, the penultimate joint slightly longer than wide; thorax and scutellum with a bronze tinge, destitute of pollen, scutellum bearing three pairs of long marginal macrochaetæ; second segment of abdomen bearing a marginal pair, the third and fourth each with a marginal row; pulvilli of front tarsi slightly longer than the last tarsal joint, wings hyaline, calypteres yellowish white; length, 9

[1] Zweif. Kais. Mus. Wien, VI, p. 192; 1893.

mm. Los Angeles, Cal. A single male specimen bred by Albert Koebele from a larva of *Sphenophorus robustus*. Type No. 3529, U. S. National Museum.....*robusta* n. sp.

Genus PHYTO Desv.

Phyto Desvoidy, Essai sur les Myodaires, p. 218; 1830.
Savia Rondani, Dipterologiæ Italicæ Prodromus, Vol. IV, p. 140; 1861.

This synonymy is given by Brauer and Bergenstamm.[1] Our species is black, including the palpi, cheeks largely reddish; front in male destitute of orbital bristles, in the female bearing two pairs; three postsutural and three sternopleural macrochætæ; length, 6 to 8 mm. Northern Illinois and Missouri. (List of Dipterous Insects, Part IV, p. 757; 1849: *Tachina*. *Phyto setosa* Coquillett, Journ. N. Y. Ent. Soc., Vol. III, p. 99; Sept., 1895.).....*clesides* Walk.

Genus MAUROMYIA, new genus.

The characters of this genus may be gleaned from the following description of the type species: Black, the palpi yellow; front in the male one and two-thirds times, in the female slightly over twice, as wide as either eye, ocellar bristles projecting obliquely forward, two pairs of orbital bristles in the female, none in the male, frontal bristles descending to base of third antennal joint, sides of face at narrowest point each one-third as wide as the median depression, thickly covered with black bristles, cheeks in the male slightly narrower, in the female broader, than the eye height, vibrissæ widely separated, inserted on a line with the front edge of the oral margin, facial ridges bristly on the lowest fourth or third, facial depression carinate in the middle, antennæ reaching the oral margin in the male, but only reaching to lowest fourth of face in the female, third joint in the male six, in the female three, times as long as the second, arista thickened on the basal half, the penultimate joint slightly longer than broad; palpi clavate, short, less than half as long as the proboscis beyond the basal articulation, the latter slightly over one-half as long as height of head, eyes bare, head in profile nearly quadrangular, as long at the vibrissæ as at base of antennæ, the face slightly concave; thorax gray pollinose, marked with three black vittæ, three postsutural and two sternopleural macrochætæ, scutellum bearing three long marginal pairs; abdomen shining, last three segments whitish pollinose at the bases, bearing discal and marginal macrochætæ; wings hyaline, tinged with smoky along the veins, third vein bristly two-thirds of distance from base to small crossvein, hind crossvein slightly curved, nearly perpendicular, situated midway between the small and the bend, the latter nearly rectangular and bearing a short appendage, apical cell closed and petiolate, the petiole almost as long as the hind crossvein; calypteres whitish; hind

[1] Zweif. Kais. Mus. Wien, VI, p. 237; 1893.

tibiæ not ciliate, front pulvilli one-half as long as the last tarsal joint; length, 5 to 6 mm. White Mountains, New Hampshire. A specimen of each sex collected by the late H. K. Morrison. Type No. 3530, U. S. National Museum..... *pulla* n. sp.

Genus CRYPTOMEIGENIA Br. and Berg.

Cryptomeigenia Brauer and Bergenstamm, Zweif. Kais. Mus. Wien, V, p. 311; 1891.
Emphanopteryx Townsend, Trans. Amer. Ent. Soc., Vol. XIX, p. 120; May, 1892.

The above synonymy has already been published by Brauer and Bergenstamm.[1] Our single species is black, the second joint of the antennæ, the palpi, tibiæ, and femora partly or wholly yellow; three postsutural and three sternopleural macrochætæ; length 7 to 10 mm. Toronto, Canada; Franconia, N. H.; Beverly, Mass.; Ithaca, N. Y.; District of Columbia; and Illinois. (List Dipt. Insects, Part IV, p. 778; 1849: *Tachina*. *Tachina prisca* Walker, loc. cit, p. 780. *Emphanopteryx eumyothyroides* Townsend, Trans. Amer. Ent. Soc., Vol. XIX, p. 121; May, 1892. Near *Peromyia*, Brauer and Bergenstamm *in litt.*)..*theutis* Walk.

Genus CERATOMYIELLA Town.

Ceratomyiella Townsend, Trans. Am. Ent. Soc., Vol. XVIII, p. 379; Dec., 1891.

Our single species is black, the palpi, base of antennæ, and the femora yellow, the tibiæ brownish yellow; three postsutural and two sternopleural macrochætæ; length, 5 mm. District of Columbia, southern Illinois, and Tifton, Ga. (Trans. Amer. Ent. Soc., Vol. XVIII, p. 380; December, 1891.)..... *conica* Town.

Genus EULASIONA Town.

Eulasiona Townsend, Trans. Amer. Ent. Soc., Vol. XIX, p. 119; May, 1892.

Our species have three postsutural and two sternopleural macrochætæ:

1. Third vein bearing a single bristle near its base, middle tibiæ each bearing a single long macrochæta on the front side near the middle, wings hyline, the bases yellowish; length, 5 to 7 mm. White Mountains and Franconia, N. H., and Georgia. (Trans. Amer. Ent. Soc., Vol. XIX, p. 120; May, 1892.)..... *comstockii* Town.

   Third vein bearing three or more bristles at the base, middle tibiæ each bearing three or more long macrochætæ on the front side near the middle..... 2.

2. Sides of face each bearing a row of macrochætæ; black, the tibiæ largely yellowish; front in female slightly wider than either eye, sides gray pollinose, two pairs of orbital bristles, frontal bristles descending slightly below base of second antennal joint, antennæ five-sixths as long as the face, the third joint two and one-fourth times as long as the second, arista thickened to the middle, the penultimate joint slightly longer than broad;

[1] Zweif. Kais. Mus. Wien, VI, p. 199; 1893.

sides of face bare except for the row of macrochætæ, cheeks two-fifths as wide as the eye-height; thorax thinly gray pollinose, marked with four black vittæ; scutellum bearing three pairs of long marginal macrochætæ; abdomen subshining, bases of last three segments lightly whitish pollinose, first segment bearing a marginal pair, second with a discal and a marginal pair of macrochætæ, third with a discal pair and a marginal row, fourth wholly covered except the extreme base; wings tinged with brown along the veins; calypteres yellowish white; length, 7 mm. Fort Wrangel, Alaska. A single female specimen collected by H. F. Wickham. Type No. 3531, U. S. National Museum ..... *spinosa* n. sp.

Sides of face each bearing only one or two macrochætæ, situated near lower end of eyes; black, the antennæ, palpi, tip of scutellum and fourth segment of abdomen yellow; front in both sexes one and two-thirds times as wide as either eye, the sides and face yellowish pollinose, two pairs of orbital bristles, frontals descending to base of third antennal joint, sides of face covered with black bristly hairs, cheeks three-fourths as broad as the eye-height, antennæ three-fourths as long as face, the third joint six times as long as the second, arista thickened on the basal third or half; thorax gray pollinose, marked with three black vittæ, scutellum bearing three long marginal pairs and a short apical pair of macrochætæ; abdomen thinly gray pollinose, subshining, last three segments bearing discal macrochætæ; wings subhyaline, veins faintly clouded with brown; length, 6 to 7 mm. Opelousas, La. Three males and one female collected in March, 1897, by Mr. G. R. Pilate ..... *setigena* n. sp.

Genus ADMONTIA Br. and Berg.

Admontia Brauer and Bergenstamm, Zweif. Kais. Mus. Wien, IV, p. 104; 1889.

On page 410 of Part V of the above-mentioned work, a species from "N. Amer." is listed as "*Admontia americana* n.," but no description of it has to my knowledge been published. Our four species have only three postsutural macrochætæ:

1. Wings wholly hyaline, or slightly smoky costally, usually three sternopleural macrochætæ ..... 2.

   Wings whitish hyaline to small crossvein, the remainder brown except the hind margin, which is hyaline; only two sternopleural macrochætæ, palpi yellow, legs black, arista thickened to beyond the middle, cheeks one-half as broad as the eye height; length, 7 mm. Northern Illinois. (Journ. N. Y. Ent. Soc., Vol. III, p. 55; June, 1895.) ..... *nasoni* Coq.

2. Legs black, two pairs of orbital bristles in both sexes ..... 3.

   Legs and palpi yellow, no orbital bristles in the male, arista thickened on less than the basal third, cheeks one-third as broad as

the eye-height, abdomen of female thickly beset with short spines on under sides of the third and fourth segments; length, 8 to 10 mm. Maryland, Dist. Columbia, and Virginia. (List Dipt. Insects, Part IV, p. 779; 1849: *Tachina.*) . . *demylus* Walk.

3. Palpi black, third antennal joint in the male eight, in the female from five to seven, times as long as the second: cheeks at least one-half as wide as the eye-height, front tarsi of female greatly dilated, abdomen destitute of stout spines on the under side. 4.

Palpi yellow, insect otherwise black; front of male as wide as either eye, frontal bristles descending to apex of second antennal joint, the pair in front of vertical ones not directed outward, cheeks one-third as broad as the eye-height, sides of face at narrowest part each one sixth as wide as the median depression, each bearing a row of bristly hairs, vibrissæ on a level with front edge of the oral margin, ridges bristly on the lowest fourth, antennæ as long as the face, the third joint four times as long as the second, arista thickened on the basal third, the penultimate joint as broad as long; thorax gray pollinose, marked with four black vittæ, scutellum bearing three pairs of long marginal and a very short apical pair of macrochætæ; abdomen thinly gray pollinose, first segment bearing marginal, the others discal and marginal macrochætæ; front pulvilli scarcely one-half as long as the last tarsal joint; wings hyaline, third vein bearing three bristles near the base, calypteres white; length, 5 mm. Alameda, Cal. Two males bred April 17, 1888, from chrysalids of *Retinia* sp. by Mr. Albert Koebele. Type No. 3532, U. S. National Museum . . . . . *retiniæ* n. sp.

4. Front in the male one and one-third times, in the female twice, as wide as either eye; the pair of frontal bristles in front of the vertical ones directed obliquely outward, arista thickened on the basal three-fifths, sides of face each bearing numerous hairs not arranged in a single row, the sides yellowish gray pollinose; length, 5 to 8 mm. From the type specimen. Beverly, Mass.; District of Columbia, and Agricultural College, Miss. (Journ. N. Y. Ent. Soc., Vol. III, p. 54; June, 1895.) . . . . *pergandei* Coq.

Front in the male slightly wider than, in the female one and one-fourth times as wide as, either eye; the pair of frontal bristles in front of the vertical ones almost perpendicular, arista thickened on the basal two-fifths, sides of face white pollinose, each bearing a single row of hairs; length, 5 to 6 mm. From the type specimen. Franconia, N. H.; Beverly, Mass.; District of Columbia; Illinois, and Tifton, Ga. (Journal N. Y. Ent. Soc., Vol. III, p. 58; June, 1895: *Hypostena.*) . . . . . *degeerioides* Coq.

Genus MEDINA Desv.

Medina Desvoidy, Essai sur les Myodaires, p. 138; 1830.
Degeeria Meigen, System. Besch. Europ. Zwei. Insekten, Vol. VII, p. 249; 1838.
Amedoria Brauer and Bergenstamm, Zweif. Kais. Mus. Wien, IV, p. 106; 1889.

The synonymy of the first two is according to Schiner.[1] Brauer and Bergenstamm state[2] that Desvoidy placed in Medina species belonging to Admontia and Degeeria, but they do not specify which of these species belong to Admontia. Since all of the recognized species placed in Medina by Desvoidy at the time of describing this genus belong to Degeeria, there would appear to be no doubt concerning the identity of these two genera. The identity of Amedoria with Degeeria has already been acknowledged by Brauer and Bergenstamm.[3] Our single species is black, with a brown tinge, the calypteres yellow, the wings strongly tinged with brown at the base and in front of the fifth vein; three postsutural and three sternopleural macrochætæ, discal macrochætæ on the last three segments of the abdomen; length, 9 mm. From the type specimen. Mount Washington, New Hampshire. (Journal N. Y. Ent. Soc., Vol. III, p. 104; Sept., 1895: *Degeeria.*) ..... *washingtona* Coq.

Genus SCHIZOTACHINA Walk.

Schizotachina Walker, Insecta Saundersiana, Vol. I, p. 264; 1856.

Our single species is black, the antennæ sometimes largely, and the palpi, yellow; three postsutural and two large and two small sternopleural macrochætæ, second and third segments of abdomen bearing only marginal ones; wings hyaline, third vein bearing a single bristle at the base; length, 4 to 6 mm. Horseneck Beach, Mass.; Waco, Tex.; and Colorado. (Insecta Saundersiana, Vol. I, p. 276; 1856: *Tachina. Tachina exul* Walker, loc. cit., p. 277.) ..... *convecta* Walk.

Genus CLAUSICELLA Rond.

Clausicella Rondani, Dipterologiæ Italicæ Prodromus, Vol. I, p. 61; 1856.

Our species have three postsutural and three sternopleural macrochætæ, body black, the abdomen sometimes with a brassy or violaceous tinge, bearing only marginal macrochætæ:

1. Wings wholly hyaline, orbital bristles present in both sexes ..... 2.
   Wings from base to tip of auxiliary vein whitish, thence to tip of second vein brown, the apex and hind margin behind the fifth vein hyaline, third vein bearing a single bristle near its base; black, the abdomen with a strong violaceous tinge; front of female one and one-third times as wide as either eye, two pairs

[1] Fauna Austriaca, Vol. I, p. 533; 1862.
[2] Zweif. Kais. Mus. Wien, VI, p. 232; 1893.
[3] Zweif. Kais. Mus. Wien, V, p. 356; 1891.

of orbital bristles, frontal bristles descending to middle of second antennal joint, antennæ as long as the face, the third joint three times as long as the second, two and one-half times as long as wide, arista thickened on the basal two-thirds, the penultimate joint three times as long as broad, two-fifths as long as the last joint; vibrissæ slightly below level of front edge of oral margin, only two or three bristles above each; thorax gray pollinose, not vittate, scutellum the same, bearing two pairs of long marginal macrochætæ and a short apical pair; abdomen gray pollinose on bases of the second and third segments, second segment bearing a marginal pair of macrochætæ, the third with a marginal, the fourth with a discal, row; calypteres white; length, 4 mm. Natrona, Pa. A single female specimen collected by Mr. C. W. Johnson, July 31, 1895. Type No. 3536, U. S. National Museum ..... *johnsoni* n. sp.

2. Third joint of antennæ in the male truncate at the apex, where it is over twice as wide as at its base, its upper edge nearly straight; length, 3 mm. Southern California; and Owl Creek Mountains, Wyoming. (Konig. Sven. Fregatt. Eugenies Resa, p. 527; 1868: *Lophosia. Clausicella antennalis* Coquillett, Journal N. Y. Ent. Soc., Vol. III, p. 56; June, 1895.) ..... *setigera* Thom.

Third joint rounded at the apex where it is at most one and one-half times as broad as at its base ..... 3.

3. Last joint of front tarsi of female over four times as long as the second, third joint of antennæ of male nearly straight on upper edge, noticeably longer than wide; length 3 to 4 mm. White Mountains, New Hampshire; Lakeland, Md.; and Northern Illinois. (Journal N. Y. Ent. Soc., Vol. III, p. 56; June, 1895. New genus near *Bigonichæta*, Brauer and Bergenstamm *in litt.*) ..... *tarsalis* Coq.

Last joint of front tarsi of female shorter than the second, third joint of antennæ of male strongly convex on upper side, only slightly longer than wide; black, the palpi yellow; front in both sexes one and one-half times as wide as either eye, two pairs of orbital bristles, frontals descending almost to tip of second antennal joint, facial ridges bristly on the lowest two-fifths to one-half, antennæ almost as long as the face, the third joint five times as long on the second, arista thickened nearly to the tip, the penultimate joint two-thirds as long as the last one; thorax gray pollinose, not black vittate, abdomen shining, bases of last three segments whitish pollinose except in the middle; wings hyaline, third vein bearing one or two bristles at the base, calypteres whitish; length, 3 to 3.5 mm. White Mountains, New Hampshire, and New Bedford, Mass. Three males and one female, the former collected by the late H. K. Morrison, the latter by Dr. Hough ..... *usitata* n. sp.

Genus PLECTOPS, new genus.

The characters of this genus may be gleaned from the table of genera given on a previous page and from the following description of the type species: Black, the palpi and apex of proboscis yellow; front in both sexes one and one-fourth times as wide as either eye, two pairs of orbital bristles, frontal bristles descending almost to apex of second antennal joint, cheeks one-fifth as broad as the eye height, eyes bare, head at vibrissæ much shorter than at base of antennæ, vibrissæ inserted on a line with front edge of the oral margin, one or two bristles above each, antennæ as long as the face, the third joint in the male three-fifths, in the female two-fifths, as broad as long, five times as long as the second, arista bare, thickened on the basal two-thirds, the penultimate joint four times as long as broad, almost one-half as long as the last joint; thorax gray pollinose, marked with four black vittæ; three postsutural and four sternopleural macrochætæ, scutellum bearing two long marginal pairs; abdomen shining, the bases of the last three segments narrowly white pollinose, bearing only marginal macrochætæ; wings hyaline, first vein bearing two or three bristles toward the tip, third vein bearing a single one at the base, hind crossvein nearly straight, midway between the small and the bend, the latter obtuse, not appendiculate, apical cell open, terminating at the extreme wing tip; calypteres white; last two joints of front tarsi of female dilated, the claws and pulvilli scarcely one-third as long as the last tarsal joint, front tarsi of male not dilated, the pulvilli slightly longer than the last tarsal joint, middle tibiæ each bearing a single bristle on the front side near the middle, hind tibiæ not ciliate; length, 4 to 5 mm. District of Columbia, and Kirkwood, Mo. Five males and one female bred from *Melissopus latiferreana* Wlsm. by Miss Mary E. Murtfeldt and this Division. Type No. 3541, U. S. National Museum.....*melissopodis* n. sp.

Genus LISPIDEA Coq.

Lispidea Coquillett, Journal N. Y. Ent. Soc., Vol. III, p. 51; June, 1895.

Our single species is black, with yellow palpi: three postsutural and two sternopleural macrochætæ; length 4 to 5 mm. Canada and northern Illinois. (Loc. cit., p. 52.).....*palpigera* Coq.

Genus THRYPTOCERA Macq.

Thryptocera Macquart, Histoire Nat. Insectes, Diptères, Vol. II, p. 87; 1835.
Herbstia Desvoidy, Annales Soc. Ent. France, p. 184; 1851. (*Non* Edwards; 1834.)

This synonymy is given by Rondani[1] and repeated by Schiner;[2]

[1] Dipterologiæ Italicæ Prodromus, Vol. III, p. 12; 1859.
[2] Fauna Austriaca, Vol. I, p. 517; 1862.

Herbstia is not mentioned by Brauer and Bergenstamm:

Penultimate joint of arista twice as long as broad, one-sixth as long as the last joint, legs black; black, the first two joints of antennæ, palpi, apex of proboscis, of scutellum, and sides of the first two segments of abdomen, yellow; third joint of antennæ brown; head at vibrissæ as long as at base of antennæ, front of female one and one-fifth times as wide as either eye, frontal bristles descending to base of third antennal joint, two pairs of orbital bristles, cheeks one-fifth as broad as the eye-height, vibrissæ on a level with front edge of oral margin, ridges bristly on the lowest fourth, antennæ nearly as long as the face, the third joint five times as long as the second, arista thickened on the basal three-fourths; thorax gray pollinose, marked with four black vittæ; three postsutural and three sternopleural macrochætæ, scutellum bearing two long marginal pairs and a very short apical pair; abdomen subopaque gray pollinose, last three segments bearing marginal macrochætæ; front tarsi slender; wings hyaline, third vein bristly halfway to small crossvein, hind crossvein midway between the small and the bend, calypteres white; length, 6 mm. New Bedford, Mass. A single female specimen, collected by Dr. Garry deN. Hough. Type No. 3543, U. S. National Museum ..... *atripes* n. sp.

Penultimate joint of arista nearly one-half as long as the last joint, femora and tibiæ yellow; frontal vitta, face and cheeks yellow, only one or two bristles above each vibrissa, third joint of antennæ three times as long as the second, arista thickened on the basal two-thirds, thorax not distinctly vittate, scutellum bearing three long marginal pairs of macrochætæ, third vein bristly almost to the small crossvein; length 4 mm.; otherwise as in the above description of *atripes*. White Mountains, New Hampshire. Two female specimens collected by Mrs. A. T. Slosson and the late H. K. Morrison. Type No. 3544, U. S. National Museum ..... *flavipes* n. sp.

Genus ACTIA Desv.

Actia Desvoidy, Essai sur les Myodaires, p. 85; 1830.
Ceromya Desvoidy, loc. cit., p. 86.
Gymnopareia Brauer and Bergenstamm, Zweif. Kais. Mus. Wien, IV, p. 103; 1889.

This synonymy is according to Brauer and Bergenstamm.[1] Our two species have four postsutural and three sternopleural macrochætæ:

First vein bristly on its apical third only, frontal vitta next the antennæ twice as wide as either side of the front, abdomen and legs yellow; length 5 mm. From the type specimen. White Mountain, New Hampshire. (Journal N. Y. Ent. Soc., Vol. III, p. 50; June, 1895: *Lasioneura. Gymnopareia* sp., Brauer and Bergenstamm *in litt.*) ..... *palloris* Coq.

[1] Loc. cit., VI, pp. 226 and 228; 1893.

First vein bristly on nearly its entire length, frontal vitta next the antennæ scarcely wider than either side of the front, abdomen and legs varying from yellow to black, fourth vein sometimes almost obsolete beyond the bend; length, 4 to 6 mm. White Mountains and Franconia, N. H.; District of Columbia; southern Illinois, and Germany. A female specimen from Germany received from Zeller, and by him labeled *Thryptocera pilipennis* Fall. (Diptera Sueciæ, Muscidæ, p. 18; 1820: *Tachina. Thryptocera americana* Townsend, Canadian Entomologist, Vol. XXIV, p. 69; March, 1892. *Gymnoparcia* sp., Brauer and Bergenstamm *in litt.*) ..... *pilipennis* Fallen.

Genus LASIONEURA Coq.

Lasioneura Coquillett, Journal N. Y. Ent. Soc., Vol. III, p. 50; June, 1895.

Our species is black, the frontal vitta, first two joints of antennæ, face, cheeks, palpi, coxæ, femora, tibiæ and sides of abdomen at base, yellow; three postsutural and three sternopleural macrochætæ; length, 5 mm. From the type specimen. Santa Cruz County, Cal.; and Washington. (Loc. cit.) ..... *johnsoni* Coq.

Genus CHÆTOPHLEPS Coq.

Chætophleps Coquillett, Journal New York Ent. Soc., Vol. III, p. 51; June, 1895.

Our single species is black, the palpi yellow; three postsutural and three sternopleural machrochætæ; abdomen of female bearing a compressed, rounded process thickly beset with short spines on the underside of the second segment, and there is a short fifth segment, both of which are absent in the male; length, 4 to 5 mm. From the type specimen. Massachusetts, Maryland, and District of Columbia. (Loc. cit.) ..... *setosa* Coq.

Genus CELATORIA Coq.

Celatoria Coquillett, Insect Life, Vol. II, p. 235; February, 1890.

Brauer and Bergenstamm, who did not recognize the species upon which this genus is founded, erroneously state that Celatoria is synonymous with Besseria.[1] Some of the principal differences existing between these two genera were pointed out by the writer in an article published in Psyche.[2] A specimen of *Celatoria diabroticæ* submitted to the above-mentioned authors was by them pronounced to belong to a new genus near Neæra. Our two species have three postsutural and three sternopleural macrochætæ:

Palpi yellow, front in both sexes wider than either eye, front pulvilli of male about one-half as long as the last tarsal joint; length, 4 to 6 mm. District of Columbia, College Station, Tex., and Cali-

[1] Zweif. Kais. Mus. Wien, VI, p. 189; 1893.
[2] Vol. VII, p. 251; 1895.

fornia. (Amer. Naturalist, Vol. V, p. 219; 1871: *Melanosphora. Celatoria cracii* Coquillett, Insect Life, Vol. II, p. 235; Feb., 1890. New genus near Nacra, Brauer and Bergenstamm *in litt.*)
diabroticæ Shimer.

Palpi black, front in male two-fifths, in the female two-thirds, as wide as either eye, front pulvilli of male as long as the last tarsal joint; black; frontal bristles descending slightly below the middle of the second antennal joint, cheeks one-seventh as wide as the eye height, facial ridges bristly on the lowest third, antennæ nearly or fully as long as the face, the third joint two and one-fourth times as long as the second, as wide as the latter is long, penultimate joint of arista shorter than broad; thorax nearly destitute of pollen except on the sides, abdomen with a narrow fascia of white pollen on the bases of the last three segments, venter of female thickly studded with short, stout spines on hind part of the second and third segments; front pulvilli of the female nearly one-half as long as the last tarsal joint; wings hyaline, slightly tinged with smoky, calypteres of female white, the hind ones in the male strongly tinged with brown except at the bases; length, 3.5 to 5 mm. Franconia and White Mountains, New Hampshire, and Los Angeles County, Cal. Two males and three females, one male from the latter locality captured by the writer in March, the others taken by Mrs. A. T. Slosson and the late H. K. Morrison. Type No. 3555, U. S. National Museum ..... *spinosa* n. sp.

Genus HYPOSTENA Meig.

Hypostena Meigen, System. Besch. Eur. Zweif. Insekten, Vol. VII, p 239; 1838.
Tachinophyto Townsend, Trans. Amer. Ent. Soc., Vol. XIX, p. 130; June, 1892.
Pseudomyothyria Townsend, loc. cit., p. 131.

This synonymy is by the writer. Our species have only three postsutural macrochætæ:

1. Third vein bearing less than six bristles at its base ..... 2.
   Third vein bristly almost or quite to the small crossvein, hind crossvein near last third of distance from the small to bend of fourth vein; black, the palpi and apex of proboscis yellow; length, 5 mm. From the type specimen. Canada; Beverly, Mass.; Hartford, Conn.; District of Columbia; North Carolina, and northern Illinois. (Journal N. Y. Ent. Soc., Vol. III, p. 54; June, 1895: *Thryptocera.*) ..... *dumningii* Coq.
2. Apical cell open or closed in the margin of the wing ..... 3.
   Apical cell closed, its petiole at least twice as long as the small crossvein; black, the palpi yellow; length, 5.5 mm. From the type specimen. Avalon, N. J., and southern California. (Journal N. Y. Ent. Soc., Vol. III, p. 55; June, 1895: *Pseudomyothyria.*) ..... *tortricis* Coq.

3. Femora and tibiæ black; three sternopleural macrochætæ, but the lowest one sometimes very small, sternopleural hairs abundant and conspicuous ..... 5.

Femora and tibiæ yellow, abdomen usually yellow, at least on the sides at base, second and third segments bearing discal macrochætæ ..... 4.

4. With three sternopleural macrochætæ, face in profile concave; black, the base of antennæ, palpi, proboscis, apex of scutellum, coxæ, femora, tibiæ, and sides of first two or three abdominal segments partly or wholly yellow; length, 8 mm. Los Angeles County, Cal. (Insecta Saundersiana, Vol. I, p. 313; 1856: *Dexia. Masicera cucurata* Bigot, Annales Soc. Entomol. France, p. 263; 1888.) ..... *pedestris* Walk.

With only two sternopleural macrochætæ, face in profile strongly convex; yellow, the apical two-thirds of the arista, upper part of the occiput except in the middle, and the middle of mesonotum black; front in the male two-fifths, in the female three-fourths, as wide as either eye, two pairs of orbital bristles in the female, wanting in the male; frontal bristles descending to tip of second antennal joint; cheeks bare, one-sixth as broad as the eye height; antennæ almost as long as the face, the third joint six times as long as the second, nearly five times as long as broad, arista minutely pubescent, thickened on the basal third; thorax grayish pollinose, marked with four black vittæ, scutellum bearing four pairs of marginal macrochætæ; venter of abdomen destitute of short, stout spines; front pulvilli of male as long, in the female one-half as long, as the last tarsal joint; wings hyaline, veins in the female bordered with yellowish, third vein bearing two or three bristles at the base; length, 7 to 8 mm. Franconia, N. H., and North Carolina. One male and female, the latter collected by Mrs. A. T. Slosson. Type No. 3549, U. S. National Museum ..... *flaveola* n. sp.

With only two sternopleurals; differs from the female of *flaveola* as follows: Black, the second antennal joint and base of the third, palpi, proboscis, femora, and tibiæ yellow, sides of abdomen basally sometimes also yellow; third joint of antennæ four times as long as the second, nearly four times as long as broad; veins not bordered with yellowish; length, 5 to 5.5 mm. New Bedford, Mass.; Cumberland County, N. J., and Tifton, Ga. Twelve females, collected by Dr. G. deN. Hough, Mr. C. W. Johnson, and Mr. G. R. Pilate ..... *gilvipes* n. sp.

5. Arista thickened on only the basal third ..... 6.

Arista thickened on the basal three-fourths, third joint of antennæ in the female three times as long as broad, front slightly wider than either eye, face in profile concave, abdomen shining, strongly tinged with bronze, base of second segment narrowly white pollinose, second and third segments destitute of discal macrochætæ,

venter destitute of short, stout spines, claws and pulvilli of female minute, the pulvilli scarcely one fifth as long as the last tarsal joint; palpi and entire insect except the wings and calypteres, black; length, 4 mm. Los Angeles County, Cal. From the type specimen. (Journal N. Y. Ent. Soc., Vol. III, p. 57; June, 1895.) ..... *ænea* Coq.

6. Palpi yellow, scutellum bearing three pairs of long marginal and sometimes a short apical pair of macrochætæ, usually a discal pair on the second and third abdominal segments ..... 7.

Palpi black ..... 8.

7. Third segment of abdomen pollinose on at least the basal two-thirds, the pollen yellowish, abdomen subopaque; length, 4 to 9 mm. Franconia and White Mountains, New Hampshire; Beverly, Mass.; Maryland; District of Columbia; Georgia; Texas; Missouri; northern Illinois; Colorado; and Sonoma County, Cal. From the type specimen. (Journal N. Y. Ent. Soc., Vol. III, p. 57; June, 1895. *Anisia nigrocincta?* v.d.W., Brauer and Bergenstamm *in litt.*) ..... *variabilis* Coq.

Third segment at most pollinose on the basal third, the pollen white, abdomen subshining; length, 4 to 9 mm. White Mountains, New Hampshire; northern Illinois; District of Columbia; Virginia; North Carolina; Tifton, Ga.; Ocean Springs, Miss.; Florida and Jamaica, West Indies. (Trans. Amer. Ent. Soc., Vol. XIX, p. 131; June, 1892: *Tachinophyto. Pseudomyothyria indecisa* Townsend, loc. cit., p. 132. *Vibrissina* sp., Brauer and Bergenstamm *in litt.*) ..... *floridensis* Town.

8. Second and third segments of abdomen destitute of discal macrochætæ, gray pollinose on bases of last three segments, third joint of antennæ nearly three times as long as the second ... 10.

Second and third segments bearing discal as well as marginal macrochætæ, scutellum bearing three pairs of long marginal macrochætæ and sometimes a very short apical pair ..... 9.

9. Abdomen gray pollinose on bases of last three segments, front in the male three-fifths, in the female from three-fifths to three-fourths, as wide as either eye; calypteres white, sometimes tinged with yellow on the margin; length, 4 to 6 mm. White Mountains and Franconia, N. H.; Beverly and New Bedford, Mass.; District of Columbia; Georgia; Illinois; Tucson, Ariz.; Palm Springs and Los Angeles Co., Cal., and Allende, Mexico. From the type specimens. (Journal N. Y. Ent. Soc., Vol. III, p. 57; June, 1895. *Hypostena pusilla*[1] Coquillett, loc. cit., p. 58.) ..... *barbata* Coq.

[1]This is the female of *barbata;* in the description of the latter, through an error in the printing, the male sign (♂) was used in the place of the female (♀), and *vice versa*. The two females from California under *barbata* do not have discal macrochætæ on the second and third segments of the abdomen, as erroneously stated in the description; they belong to *vanderwulpi* Town.

Abdomen wholly shining and destitute of pollen; front in male three fifths as wide as either eye; wholly black, no orbital bristles in male, frontals descending below the arista, facial ridges bristly to the lowest frontal bristles, antennæ as long as face, the third joint six times as long as the second, arista thickened on the basal two-fifths; thorax shining, a whitish pollinose vitta in the middle in front of the suture, lateral edges also whitish pollinose; wings hyaline, two bristles at base of third vein, calypteres whitish; length, 4 mm. Biscayne Bay, Florida. A single male specimen collected by Mrs. A. T. Slosson ... *nitens* n. sp.

10. Front of female only two-thirds as wide as either eye, facial ridges bare, scutellum bearing only two pairs of long marginal macrochætæ, third joint of antennæ three times as long as wide; length, 3.5 mm. St. Augustine, Fla. (Proceedings Acad. Nat. Sci. Phila., p. 313; Sept., 1895.) ..... *maculosa* Coq.

Front of female almost as wide as either eye, facial ridges bristly on the lower half, scutellum bearing three pairs of long marginal macrochætæ; basal three-fifths of the last three segments of abdomen, except a dorsal vitta on the first two, gray pollinose; length, 5 mm. Los Angeles County, Cal. (Entom. News, Vol. III, p. 131; June, 1892: *Myothyria.*) ..... *vanderwulpi* Town.

Genus **DIDYMA** v. d. W.

Didyma van der Wulp, Biologia Cent.-Amer., Diptera, Vol. II, p. 156; June, 1890.

Our species are black, with at most the palpi and sides of the abdomen partly yellow, hind tibiæ on the outer side ciliate with short bristles:

1. Second, or at least the third, abdominal segment bearing discal macrochætæ ..... 2.

Second and third, abdominal segments destitute of discal macrochætæ, palpi yellow, hind crossvein slightly curved, nearer to the bend of the fourth vein than to the small crossvein; length, 6 mm. Lake Worth, Fla. (Biol. Cent.-Amer., Dipt., Vol. II, p. 163; June, 1890.) ..... *inconspicua* v. d. W.

2. Hind crossvein curved S-shape, nearer to the bend of the fourth vein than to the small crossvein, palpi yellow; length, 4.5 mm. Kirkwood, Mo. (Biol. Cent.-Amer., Dipt., Vol. II, p. 160; June, 1890.) ..... *exigua* v. d. W.

Hind crossvein almost straight, midway between the small and the bend, palpi black; length, 5 mm. District of Columbia. (Biol. Cent.-Amer., Dipt., Vol. II, p. 161; June, 1890.) .. *timida* v. d. W.

Genus MACQUARTIA Desv.

Macquartia Desvoidy, Essai sur les Myodaires, p. 204; 1830.
Amedea Desvoidy, loc. cit., p. 207.
Albinia Desvoidy, loc. cit., p. 209.
Aporia Macquart, Diptères Exotiques, Supp. I, p. 168; 1846. (*Non* Huebner; 1816.)

This synonymy, with the exception of the last one, is given by Schiner;[1] the name of Aporia having previously been employed in the Lepidoptera, the species heretofore placed in this genus may with propriety be placed in Macquartia, to which genus our species has been referred by Brauer and Bergenstamm *in litt.* Our single species is black, the base of the antennæ, palpi, and apex of proboscis, yellow; three postsutural and two sternopleural macrochætæ; length, 8 to 10 mm. Mount Washington, N. H.; New Bedford, Mass.; District of Columbia; Aurora Mills, Oreg., and Siskiyou County, Cal. (List of Dipterous Insects, Part IV, p. 841; 1849: *Dexia*. *Aporia limacodis* Townsend, Psyche, Vol. VI, p. 275; June, 1892. *Macquartia* sp., Brauer and Bergenstamm *in litt.*) ..... *pristis* Walk.

Genus HYALURGUS Br. and Berg.

Hyalurgus Brauer and Bergenstamm, Zweif. Kais. Mus. Wien, VI, p. 136; 1893.

Our species is black, the base of antennæ, palpi, apex of proboscis, scutellum, tibiæ, and tarsi, yellow; three postsutural and three sternopleural macrochætæ, last three segments of abdomen bearing discal and marginal macrochætæ, middle tibiæ each bearing three macrochætæ on the front side near the middle; length, 7 mm. Illinois. (Can. Entomologist, Vol. XXIV, p. 81; April, 1892: *Macquartia*.) ..*johnsoni* Town.

Genus POLIDEA Macq.

Harrisia Meigen, System. Besch. Eur. Zweif. Insekten, Vol. VII, p. 260; 1838. (*Non* Desvoidy; 1830.)
Polidea Macquart, Annales Soc. Ent. France, p. 92; 1848.
Somoleja Rondani, Atti Soc. Italiana Sci. Nat., Vol. VIII, p. 35; 1865.

Polidea was proposed for the genus Harrisia of Meigen, the latter name having been previously used in the Diptera. According to Brauer and Bergenstamm, Harrisia of Meigen is identical with Somoleja of Rondani.[2] Our single species has the body and sides of the front shining black, with a tinge of bronze, almost destitute of pollen; three postsutural and three sternopleural macrochætæ, last three segments of abdomen bearing discal ones, third vein bristly at least halfway from base to small crossvein, middle tibiæ each bearing two or more macrochætæ on the front side near the middle; length, 5 to 7 mm. Georgetown, Canada; White Mountains and Franconia, N. H.; New Bedford, Mass.;

[1] Fauna Austriaca, Vol. I, p. 528; 1862.
[2] Zweif. Kais. Mus. Wien, VI, p. 231; 1893.

South Windsor, Conn.; Constantine, Mich.; Northern Illinois, and Los Angeles County, Cal. (List of Dipterous Insects, Part IV, p. 766; 1849: *Tachina*. *Tryphera americana* Townsend, Can. Entomologist, Vol. XXIV, p. 78; April, 1892. *Tryphera polidoides* Townsend, loc. cit., p. 79. *Polidea americana* Townsend, loc. cit., p. 82: from a cotype specimen. *Somoleja* sp., Brauer and Bergenstamm *in litt.*) *arcos* Walk.—

Genus HYPOCHÆTA Br. and Berg.

Hypochæta Brauer and Bergenstamm, Zweif. Kais. Mus. Wien, IV, p. 93; 1889.

The type species is black, the first two antennal joints, palpi, apex of proboscis, and the tibiæ, yellowish; three postsutural and two sternopleural macrochætæ; length, 5 mm. White Mountains, N. H. (Fauna Austriaca, Vol. I, p. 527; 1862: *Frivaldskia*.) .....*longicornis*[1] Schiner.

Genus PELATACHINA Meade.

Hyria Desvoidy, Histoire Naturelle Diptères, p. 1100; 1863. (*Non* Lamarck, 1819; *non* Stephens, 1829.)

Pelatachina Meade, Entomologists' Monthly Magazine, Vol. XXX, p. 109; 1894.

The above name was proposed for the genus Hyria of Desvoidy, the latter name having been previously used in the Mollusca and also in the Lepidoptera. Our single species is black, including the palpi; front of female as wide as either eye, two pairs of orbital bristles, and behind the posterior pair a pair of outwardly curving macrochætæ slightly in front of the lowest ocellus; frontal bristles descending to basal fourth of the second joint of the antennæ, face golden yellow pollinose, cheeks nearly one-third as broad as the eye-height, vibrissæ on a level with front edge of oral margin, ridges bristly on the lowest fourth, antennæ nearly as long as the face, the third joint one and one-half times as long as the second, arista thickened on the basal two-fifths, the penultimate joint broader than long; thorax gray pollinose, marked with three black vittæ, three postsutural and three sternopleural macrochætæ, scutellum bearing three long marginal pairs, abdomen gray pollinose and with darker reflecting spots, hairs depressed, first segment bearing a marginal pair of macrochætæ, second with two discal and a marginal pair, third with three discal pairs and a marginal row; middle tibiæ each bearing three or more on the front side near the middle; wings hyaline, third vein bearing two bristles near the base, fourth vein beyond the bend arcuate; calypteres white, narrowly margined with brown; length, 9 mm. No locality, but evidently from the United States. A single female specimen. Type No. 3546, U. S. National Museum. (*Hyria* sp., Brauer and Bergenstamm *in litt.*) ....*pellucida* n. sp.

[1] This species is referred by Schiner to the *Tachina longicornis* of Fallen, but judging from the description the two species are very distinct, a conclusion already reached by Brauer and Bergenstamm.

Genus RACODINEURA Rond.

Roeselia Desvoidy, Essai sur les Myodaires, p. 145; 1830. (*Non* Huebner, 1816.)
Racodineura Rondani, Dipterologiæ Italicæ Prodromus, Vol. IV, p. 31; 1861.

The latter term was proposed by Rondani to take the place of Roeselia, which had previously been used in the Lepidoptera. Our single species is black, the antennæ, lower part of face, palpi, femora, and tibiæ yellow; front of female slightly over twice as wide as either eye, two pairs of orbital bristles, frontal bristles descending to tip of second antennal joint; sides of face at narrowest point each almost one-half as wide as the median depression, thinly bristly one fifth of distance from lowest frontal to the vibrissæ, the latter on a level with front edge of oral margin; ridges bristly on the lower half, but the uppermost bristles very short; cheeks slightly over one-half as broad as the eye height; antennæ almost as long as the face, the third joint five times as long as the second, arista thickened to the middle, the penultimate joint broader than long; thorax gray pollinose, marked with four black vittæ, four postsutural and three sternopleural macrochætæ; scutellum bearing four long marginal pairs; abdomen opaque gray pollinose, first three segments bearing marginal macrochætæ, middle tibiæ each bearing three or more on the front side near the middle; wings hyaline, the base grayish, third vein bearing a single bristle near the base, hind crossvein nearly straight, midway between the small and the bend of the fourth; calypteres white; length, 9 mm. Tifton, Ga. A female specimen collected October 1, 1896, by Mr. G. R. Pilate. Type No. 3545, U. S. National Museum ..... *americana* n. sp.

Genus ERVIA Desv.

Ervia Desvoidy, Essai sur les Myodaires, p. 225; 1830.

Our single species is black, the face and more or less of the antennæ, femora, and tibiæ, also the greater portion of the sides of the first three segments of the abdomen in the male, yellow; three postsutural and three sternopleural macrochætæ; length, 7 to 10 mm. Agricultural College, Miss., and Lufkin, Tex. (Encyclopédie Méthodique, Vol. VIII, p. 423; 1811: *Ocyptera.*) ..... *triquetra* Oliv.

Genus LESKIA Desv.

Leskia Desvoidy, Essai sur les Myodaires, p. 100; 1830.
Myobia Desvoidy, loc. cit., p. 98. (*Non* Heyden; 1826.)
Solieria Desvoidy, Annales Soc. Ent. France, p. 461; 1848.
Orillia Desvoidy, loc. cit., p. 474.
Anthoica Rondani, Dipterologiæ Italicæ Prodromus, Vol. IV, p. 8; 1861.
Pyrrosia Rondani, loc. cit., p. 48.

Rondani proposed the name Anthoica for Myobia, which is preoccupied in the Arachnida, and erected the genus Pyrrosia to include Leskia, Solieria, and Orillia. Brauer and Bergenstamm place Leskia and

Myobia as subgenera of Pyrrosia,[1] but make no mention of the other three names. Our species have yellow legs; three postsutural and three sternopleural macrochætæ:

Scutellum largely or wholly black; abdomen yellow, in the male marked with a dorsal vitta and usually the base of the fourth segment, in the female with a dorsal vitta on the first two segments, black; length, 6 mm. Bucks and Delaware counties, Pa. (Journal N. Y. Ent. Soc., Vol. III, p. 105; Sept., 1895: *Myiobia.*) ..... *thecata* Coq.

Scutellum and abdomen yellow, last two or three segments of the latter sometimes marked with a dorsal spot of brown or black; length, 7 to 11 mm. Andover, Mass.; Ithaca, N.Y.; Jacksonville, Fla., and Onaga, Kans. (Journal Acad. Nat. Sciences Phila., Vol. VI., p. 177; 1829: *Dexia. Myiobia depile* Coquillett, Proc. Acad. Nat. Sciences Phila., p. 313; Sept., 1895.) .... *analis* Say.

Genus LESKIOMIMA Br. and Berg.

Leskiomima Brauer and Bergenstamm, Zweif. Kais. Mus. Wien, V, p. 372; 1891.

The type species is yellow, the upper part of the occiput, dorsum of thorax, tarsi, and usually a few spots on the abdomen, black; usually three postsutural and three sternopleural macrochætæ; length, 6 to 8 mm. White Mountains and Franconia, N. H.; New York, N. Y.; Chester County, Pa.; Virginia; North Carolina, and Lake Worth, Florida. (Ausser. Zweif. Insekten, Vol. II, p. 251; 1830: *Stomoxys. Leskiomima tenera* Wied., Brauer and Bergenstamm *in litt.*) ..... *tenera* Wied.

Genus APINOPS, new genus.

The characters of this new genus may be gleaned from the following description of the type species: Black; head at vibrissæ slightly longer than at base of antennæ; front, including the vitta, gray pollinose, in the male about one half, in the female two-thirds, as wide as either eye; ocellar bristles directed forward, frontal bristles descending nearly to middle of second antennal joint; three pairs of orbital bristles in the female, wanting in the male; antennæ six-sevenths as long as the face, third joint one and one-half times as long as the second, rounded at the tip, arista bare, thickened to the middle, the penultimate joint slightly longer than broad; sides of face bare, each at narrowest part scarcely one-tenth as wide as the median depression; vibrissæ strong, situated on a line with front edge of oral margin, two or three bristles above each; cheeks one-seventh as wide as the eye height; proboscis slender, rigid, the portion beyond the basal articulation one and one sixth times as long as height of head, labella not developed; palpi minute, scarcely longer than broad, tipped with a short bristle; thorax grayish pollinose, marked with four black

[1] Zweif. Kais. Mus. Wien, VI, p. 140; 1893.

vittæ; three postsutural and two sternopleural macrochætæ; scutellum bearing three pairs of long marginal macrochætæ; abdomen shining, a pair of marginal macrochætæ on the first and second segments and a marginal row on the third; genitalia projecting at least twice the length of the fourth abdominal segment beyond the latter, curved beneath the abdomen; first segment of abdomen in the female greatly dilated ventrally; hind tibiæ not ciliate with bristles; front pulvilli in female one-half as long as, in the male about as long as, the last tarsal joint; wings hyaline, a single bristle at base of the third vein, other veins bare, apical cell open at the extreme tip of wing, bend of fourth vein arcuate, hind crossvein nearly perpendicular, midway between the small crossvein and bend of the fourth vein; calypteres white; length, 4 to 5 mm. Southern Illinois. Two males and one female collected by Charles Robertson. Type No. 3559, U. S. National Museum. *atra* n. sp.

Genus LEUCOSTOMA Meig.

Leucostoma Meigen, in Illiger's Magazin für Insektenkunde, Vol. II, p. 279; 1803.
Clelia Desvoidy, Essai sur les Myodaires, p. 255; 1830.
Psalida Rondani, Dipterologiæ Italicæ Prodromus, Vol. I, p. 76; 1856.

This synonymy is given by Schiner[1] and repeated by Brauer and Bergenstamm.[2] Our species are black, the palpi sometimes yellow; three sternopleural and usually three postsutural macrochætæ:

1. Thorax shining, almost destitute of pollen, frontal vitta at the lowest ocellus narrower than either side of the front at the same point, scutellum bearing three pairs of marginal macrochætæ, first two segments of abdomen each bearing a marginal pair, palpi yellow ..... 2.

   Thorax opaque, densely gray pollinose, frontal vitta of female at the lowest ocellus twice as wide as either side of the front, palpi black; front of female one and one-third times as wide as either eye, two pairs of orbital bristles, cheeks one-sixth as wide as the eye-height, antennæ two thirds as long as the face, the third joint as long as the second, arista thickened on the basal three-fifths, the penultimate joint shorter than broad; thorax not distinctly vittate, scutellum densely gray pollinose, bearing two pairs of long marginal macrochætæ, abdomen shining, basal half of the last three segments gray pollinose, first two segments destitute of macrochætæ, those of the other two segments very short, genitalia of female claw-like, curved beneath the body; wings hyaline, third vein bearing two or three bristles near the base, hind crossvein straight, one and one-third times as long as the last section of the third vein, situated midway between the small crossvein and the bend; calypteres white; length, 5 mm. Clementon, N. J. A single female specimen collected

[1] Fauna Austriaca, Vol. I, p. 542; 1862.
[2] Zweif. Kais. Mus. Wien, VI, Index; 1893.

May 30, 1895, by Mr. C. W. Johnson. Type No. 3563, U. S. National Museum ..... *subopaca* n. sp.

2. Abdomen entirely destitute of pollen; length, 4 to 5 mm. White Mountains, New Hampshire; Massachusetts, and northern Illinois. (Trans. Amer. Ent. Soc., Vol. XVIII, p. 380; December, 1891.) ..... *atra* Town.

Abdomen grayish pollinose on the bases of the last three segments; length, 4.5 to 7 mm. Maryland; Tifton, Ga.; Las Cruces, N. Mex.; Canon City, Colo., and Washington. (Can. Entomologist, Vol. XXIV, p. 81; April, 1892: *Phyto. Leucostoma neomexicana* Townsend, loc. cit., p. 169; July. *Phyto nigricornis* Townsend, loc. cit., p. 170; from a cotype specimen.) ..... *senilis* Town.

Genus SCIASMA, new genus.

The characters of this genus may be gleaned from the table of genera given in a previous part of the present work and from the following description of the type species: Black, the antennæ and palpi yellow, the femora sometimes partly or wholly yellow; front of male from as wide to twice as wide, in the female six times as wide, as width of lowest ocellus, bare except the frontal bristles which descend to base of second antennal joint, ocellar bristles wanting, two pairs of orbital bristles in the female, wanting in the male; cheeks one-tenth as wide as the eye-height, sides of face bare, each scarcely as wide as the lowest ocellus, eyes bare, vibrissæ on a level with front edge of oral margin, two or three bristles above each; head at vibrissæ almost as long as at base of antennæ, antennæ from three-fourths to four-fifths as long as the face, the third joint twice as long as the second, arista bare, thickened on the basal fourth, the penultimate joint shorter than broad; body shining, destitute of pollen; two postsutural and three sternopleural macrochætæ, scutellum bearing two marginal pairs, abdomen of four segments, the first two destitute of dorsal macrochætæ, the third and fourth each with a marginal row, genitalia of male large, curved beneath the third and fourth segments of the abdomen, in the female nearly concealed in the fourth segment; wings hyaline, costal cell brown, a brown spot extending from the hind crossvein to tip of second vein, and from the costa to the fourth or fifth vein; third vein bearing a single bristle at its base, hind crossvein straight, at first third or two-fifths of distance from the small to bend of fourth, the latter arcuate and destitute of an appendage, apical cell closed, third vein ending at the extreme wingtip, its last section as long as the hind crossvein; calypteres white except apical half of hind ones, which is black; hind tibiæ not ciliate, dilated in the male, front pulvilli in both sexes almost as long as the last tarsal joint; length, 3 to 4 mm. New Bedford, Mass.; Jamesburg, N. J., and Tifton, Ga. Twenty-six males and one female, collected by Dr. Garry deN. Hough, Mr. C. W. Johnson, and Mr. G. R. Pilate. Type No. 3561, U. S. National Museum ..... *nebulosa* n. sp.

Genus HYALOMYODES Town.

Hyalomyodes Townsend, Psyche, Vol. VI, p. 429; April, 1893.

Our single species is black, the palpi yellow; eyes of male almost contiguous, but in the female separated at least one and one-half times the width of the lowest ocellus; abdomen on last three segments gray pollinose, the second and third segments in the female each bearing a pair of large triangular black spots, indistinct or wanting in the male; front pulvilli of female less than two-thirds as long as the last tarsal joint; length, 4 to 5 mm. White Mountains, N. H.; New Bedford, Mass.; Maryland; Tifton, Ga., and Colorado. (Dipt. Amer. Sept. Indig., Centuria IV, No. 85: 1863: *Hyalomyia. Hyalomyodes weedii* Townsend, Psyche, Vol. VI, p. 430; April, 1893.) . . *triangulifera* Loew.

Genus ŒSTROPHASIA Br. and Berg.

Œstrophasia Brauer and Bergenstamm, Zweif. Kais. Mus. Wien, IV, p. 145; 1889.
Phasiopteryx Brauer and Bergenstamm, loc. cit., p. 146.
Neoptera van der Wulp, Biol. Cent.-Amer., Diptera, Vol. II, p. 165; June, 1890.
Cenosoma van der Wulp, loc. cit., p. 166.
Euœstrophasia Townsend, Trans. Amer. Ent. Soc., Vol. XIX, p. 133; June, 1892.

The synonymy of the last two with Œstrophasia, and of Neoptera with Phasiopteryx, has already been given by Brauer and Bergenstamm.[1] Phasiopteryx is not sufficiently distinct from Œstrophasia to be retained as a distinct genus. Our species have three postsutural and two sternopleural macrochætæ:

1. Wings destitute of brown markings . . . . . 3.
   Wings distinctly marked with brown . . . . . 2.
2. Discal cell crossed by a brown crossband, hind crossvein not wholly bordered with brown, a brown border to the fifth vein and a brown crossband beyond the discal cell; yellow, an ocellar dot and usually from one to three spots or a fascia on hind margin of each segment of the abdomen, and sometimes one or more on the thorax, black; length, 4 to 5 mm. Toronto, Canada; Franconia, N. H.; Philadelphia, Pa., and Florida. (Biol. Cent.-Amer., Diptera, Vol. II, p. 167; June, 1890: *Cenosoma.*) . . *signifera* v. d. W.
   Discal cell not crossed by a brown crossband, hind crossvein bordered with brown, second basal and anal cells, and wing in front of third vein from humeral to slightly beyond small crossvein, also a brown crossband extending over the hind crossvein and bordering the fifth vein except near base of discal cell, brown; yellow, the upper part of the occiput sometimes blackish, thorax sometimes black dorsally, or with two vittæ and an anterior spot black; abdomen with the hind margin of each segment

[1] Zweif. Kais. Mus. Wien, VI, pp. 218 and 234; 1893.

black and sometimes with a black dorsal vitta; length, 5.5 mm. Tewksbury, Mass., and Veta Pass, Colorado. (Zweif. Kais. Mus. Wien, IV, p. 145; 1889: also *in litt.*) ..... *clausa* Br. and Berg.

3. Antennæ reaching at least halfway to the oral margin, the tip less than the length of the second joint from the point where the facial ridges approach each other the most closely; submarginal cell in the male scarcely over one-half as wide as the greatest distance from the third vein to the hind margin of the wing, front in the female noticeably widening anteriorly ..... 4.

Antennæ reaching two-fifths of distance from their base to the oral margin, the tip nearly three times the length of the second joint from the point where the facial ridges approach each other the most closely; front in female three-fourths as wide as either eye, its sides parallel. (According to Brauer and Bergenstamm, the submarginal cell in the male is as wide as the greatest distance from the third vein to the hind margin of the wing, and the second vein near its middle and the costa opposite it are greatly swollen.) Length, 8 mm. Texas. (Zweif. Kais. Mus. Wien, IV, p. 147; 1889: *Phasiopteryx.* Also *in litt.*) .. *bilimekii* Br. and Berg.

4. Front in the male nearly one-half, in the female two-thirds, as wide as either eye; second vein in the male with a large swelling near the middle and another on the costa opposite it; submarginal cell almost twice as wide as length of the hind crossvein; length, 5.5 to 7 mm. Charlotte Harbor, Florida. (Journal N. Y. Ent. Soc., Vol. III, p. 52; June, 1895: *Clytiomyia. Phasiopteryx bilimekii* Br. and Berg., Brauer and Bergenstamm *in litt.*) ..... *punctata* Coq.

Front in the male scarcely one-eighth, in the female one and one-third times, as wide as either eye; second vein destitute of a swelling, submarginal cell less than two-thirds as wide as length of hind crossvein; length, 7 to 8 mm. Georgia, Texas, and Colorado. (Annales Soc. Entomol. France, p. 268; 1888: *Pyrrosia.*) ..... *ochracea* Bigot.

Genus CLYTIOMYIA Rond.

Clytia Desvoidy, Essai sur les Myodaires, p. 287; 1830. (*Non* Lamarck, 1812; *non* Huebner, 1816.)

Clytiomya Rondani, Dipterologiæ Italicæ Prodromus, Vol. IV, p. 9; 1861.

The latter term was proposed to take the place of Clytia, which had been used twice previously as a generic name. Our species have three postsutural and two sternopleural macrochætæ:

Legs black, entire insect, except the yellow palpi, black; calypteres white, wings hyaline; length, 7 mm. Washington. (Journal N. Y. Ent. Soc., Vol. III, p. 53; June, 1895.) ..... *atrata* Coq.

Legs yellow; head and its members except the eyes and upper part of the occiput, usually the apex of scutellum, and abdomen

except a dorsal row of spots and the hind edges of the last two segments, yellow; last two segments of abdomen sometimes almost wholly black; length, 5 to 8 mm. White Mountains, New Hampshire, and Agricultural College, Miss. (Trans. Am. Ent. Soc., Vol. XVIII, p. 372; December, 1891: *Clytia*. *Redtenbacheria* sp., Brauer and Bergenstamm *in litt.*).....*flava* Town.

Genus EUTRIXA, new genus.

The principal characters of this genus have been given in the table of genera on previous pages of this work. The type species is black, the lower part of the front, face, antennæ, base of arista, cheeks, proboscis, palpi, femora, and tibiæ, yellowish; apex of antennæ and the proboscis sometimes brown; three postsutural and two sternopleural macrochætæ; apex of antennæ less than the length of the second antennal joint from the point where the facial ridges approach each other the most closely; length, 6 to 8 mm. Franconia, N. H.; Maryland, and District of Columbia. (List of Dipterous Insects, Part IV, p. 753; 1849: *Tachina*. *Cistromyia exile* Coquillett, Journal N. Y. Ent. Soc., Vol. III, p. 53; June, 1895.).....*masuria* Walk.

Genus XANTHOMELANA v. d. W.

Xanthomelana van der Wulp, Tijd. voor Entomologie, Vol. XXXV, p. 188; 1892.
Xanthomelanodes Townsend, Canadian Entomologist, Vol. XXV, p. 167; July, 1893.

The latter name was proposed for Xanthomelana under the mistaken idea that this name is preoccupied by Xanthomelon; but the two terms do not conflict with each other. Our two species have three postsutural macrochætæ, scutellum bearing two marginal pairs; wings on costal half or less brown, the remainder hyaline or subhyaline:

1. Oral margin bearing black macrochætæ in addition to the vibrissæ, legs black, bases of femora yellow..... 2.

   Oral margin destitute of black macrochætæ besides the vibrissæ, legs yellow, apices of tibiæ and the tarsi black; black, the antennæ, face, cheeks, palpi, abdomen except a spot on each side of first segment at its base and a triangular dorsal spot on posterior part of second and third segments, coxæ, femora, and tibiæ except the apices, yellow; abdomen shining, the fourth segment and sometimes the base of the third thinly yellowish pollinose; wings hyaline, the costal margin to slightly below the third vein smoky brown; posterior calypteres yellow, the bases white; length, 7 mm. Horseneck Beach, Mass. A specimen of each sex collected August 4, 1896, by Dr. Garry deN. Hough. Type No. 3568, U. S. National Museum.....*flavipes* n. sp.

2. Abdomen black, sides of first two segments and usually the front corners of the third, yellowish, front femora almost wholly black, three sternopleural macrochaetæ: length, 6 mm. Colorado and southern California. (Jour. Acad. Nat. Sci. Philadelphia, Vol. VI, p. 173; 1829: *Oeyptera. Sterenia pictipes* Bigot, Ann. Soc. Ent. France, p. 254; 1888.) ..... *arcuata* Say.

Abdomen wholly yellow, front femora broadly yellow at the base; two sternopleural macrochætæ; length, 6 mm. Northern Virginia. (Jour. Acad. Nat. Sci. Philadelphia, Vol. VI, p. 172; 1829: *Phasia. Tachina corythus* Walker, List of Dipterous Insects, Part IV, p. 797; 1849. *Wahlbergia atripennis* Townsend, Proc. Ent. Soc. Washington, Vol. II, p. 145; April 2, 1891.) ..... *atripennis* Say.

Genus HEMYDA Desv.

Hemyda Desvoidy, Essai sur les Myodaires, p. 226; 1830.

Our single species is black, the palpi, humeri, a large spot on each side of the second abdominal segment at the middle, the front corners of the third segment, the coxæ, tibiæ and a large portion of the femora, yellow; three postsutural and one sternopleural macrochætæ, scutellum bearing three marginal pairs; frontal vitta highly polished; length, 11 mm. Northern Illinois. (Loc. cit.) ..... *aurata* Desv.

Genus BESKIA Br. and Berg.

Beskia Brauer and Bergenstamm, Zweif. Kais. Museum Wien, IV, p. 139; 1889.
Oeypterosipha Townsend, Journal N. Y. Ent. Soc., Vol. II, p. 79; June, 1894.

This synonymy has already been published by Dr. Williston.[1] The type species is black, the abdomen yellow, calypteres white, wings smoky, three postsutural and three sternopleural macrochætæ: length, 6 mm. Boykins, Va.; Tifton, Ga.; and Texas. (List of Dipterous Insects, Part IV, p. 796; 1849: *Tachina. Beskia cornuta* Brauer and Bergenstamm, Zweif. Kais. Mus. Wien, IV, p. 170; 1889. *Oeypterosipha willistoni* Townsend, Journal N. Y. Ent. Soc., Vol. II, p. 79; June, 1894.) ..... *elops* Walk.

Genus ISOGLOSSA Coq.

Isoglossa Coquillett, Canadian Entomologist, Vol. XXVII, p. 125; May, 1895.

The type species is black, the palpi, sides of last three abdominal segments except the hind margins of the second and third, and the apex of the abdomen, yellow; three postsutural and three sternopleural macrochætæ; length, 6 mm. From the type specimen. Los Angeles County, Cal. (Loc. cit., p. 126.) ..... *hastata* Coq.

[1] Manual N. Amer. Diptera, p. 149; 1896.

Genus EPIGRIMYIA Town.

Epigrimyia Townsend, Trans. Amer. Ent. Soc., Vol. XVIII, p. 375; December, 1891.
Drepanoglossa Townsend, loc. cit., p. 377.
Siphoclytia Townsend, loc. cit., Vol. XIX, p. 117; May, 1892.
Siphophyto Townsend, loc. cit., p. 127.
Coronimyia Townsend, loc. cit., p. 128; June, 1892.

This synonymy is original with the writer, and, in the case of Drepanoglossa, is based upon cotypes received from Mr. Townsend. The open or closed apical cell is not a character of generic importance; in a given species, some specimens have it open while in others it is closed. All of our species have on the fourth segment of the abdomen only a submarginal row of macrochætæ:

1. Femora yellow, three postsutural and three sternopleural macrochætæ ..... 2.
   Femora and tibiæ black ..... 4.
2. Scutellum yellow ..... 3.
   Scutellum and proboscis black, the latter beyond the basal articulation one and one-third times as long as height of head, fourth segment of abdomen reddish yellow, sides of first two segments usually yellow; length, 4 to 7 mm. Tifton, Ga. (Trans. Amer. Ent. Soc., Vol. XIX, p. 117; May, 1892: *Siphoclytia.*)
   robertsonii Town.
3. Arista thickened on at least the basal two-fifths, proboscis beyond the basal articulation twice as long as height of head, three times as long as the palpi; length, 6 mm. From two cotype specimens. Las Cruces, N. Mex. (Trans. Amer. Ent. Soc., Vol. XVIII, p. 378; December, 1891: *Drepanoglossa.*) ... *lucens* Town.
   Arista thickened on the basal fourth, proboscis one and one-half times as long as height of head, twice as long as the palpi; length, 8 mm. Southern California. From the type specimen. (Canadian Entomologist, Vol. XXVII, p. 126; May, 1895: *Drepanoglossa.*) ..... *occidentalis* Coq.
4. Abdomen not pollinose on broad apex of each segment ..... 5.
   Abdomen wholly pollinose, three postsutural and three sternopleural macrochætæ, proboscis beyond the basal articulation one and one-half times as long as height of head, palpi yellow; length, 5 mm. From the type specimen. California. (Canadian Entomologist, Vol. XXVII, p. 128; May, 1895: *Siphophyto.*) .. *opaca* Coq.
5. Palpi yellow ..... 6.
   Palpi black, three postsutural and three sternopleural macrochætæ, proboscis one and three-fourths times as long as height of head; length, 5 mm. White Mountains, New Hampshire; Woodbury, N. J.; Suffolk, Va., and Tifton, Ga. (Trans. Amer. Ent. Soc., Vol. XVIII, p. 376; December, 1891.) ..... *polita* Town.

6. Proboscis at most one and one-half times as long as height of head, three postsutural and four sternopleural macrochaetæ, second and third segments of abdomen shining except on base of each ..... 7.

Proboscis three times as long as height of head, four postsutural and four sternopleural macrochaetæ, second and third segments of abdomen each marked with two shining black, triangular spots; length, 5 mm. Maryland. (Trans. Amer. Ent. Soc., Vol. XIX, p. 129; June, 1892: *Coronimyia.*) ..... *geniculata* Town.

7. Third joint of antennæ strongly concave on the front edge; length, 5 mm. White Mountains, New Hampshire; District of Columbia; Virginia, and Southern Illinois. (Trans. Amer. Ent. Soc., Vol. XIX, p. 128; May, 1892: *Siphophyto. Siphophyto neomexicanus* Townsend, l. c. *Gymnopareia americana* Br. and Berg. MSS., Brauer and Bergenstamm *in litt.*) ..... *floridensis* Town.

Third joint of antennæ strongly convex on the front edge; length, 4 mm. Southern California. (Canadian Entomologist, Vol. XXVII, p. 127; May, 1895: *Siphophyto.*) ..... *setigera* Coq.

Genus SIPHONA Meig.

Siphona Meigen, in Illiger's Magazin für Insektenkunde, Vol. II, p. 281; 1803.
Bucentes Latreille, Genera Crust. et Insectorum, Vol. IV, p. 339; 1809.

This synonymy is given by St. Fargeau and Serville,[1] and repeated by most later authors. Our species have three postsutural and three sternopleural macrochaetæ, third vein bristly at least halfway to the small crossvein, two pairs of orbital bristles in both sexes, palpi and greater part of femora and tibiæ yellow:

1. Terminal section of proboscis laterally compressed and widened, at most three-fourths as long as height of head ..... 2.

Terminal section bristle-like, at least as long as height of head; abdomen opaque gray pollinose, black, the sides of the first two or three segments sometimes partly or wholly yellow; length, 3 to 6 mm. Toronto, Canada; White Mountains and Franconia, N. H.; Beverly, Mass.; District of Columbia; North Carolina; northern Illinois; Colorado; England, and Austria. Two males and one female from Austria received from Brauer and Bergenstamm, and by them labeled *Siphona geniculata* Meig.; also three females from England, received from E. Brunetti, and by him labeled *Siphona geniculata.* (Memoires servir Histoire Insectes, Vol. VI, p. 20; 1776: *Musca.* The following synonymy is by St. Fargeau and Serville, in Encycl. Méthodique, Vol. X, p. 501; 1828: *Stomoxys minuta* Fabricius, Systema Antliatorum, p. 282; 1805. The following is by Meigen, in Syst. Besch. Eur. Zweif. In., Vol. IV, p. 154, 1824, and repeated by most later authors: *Bucentes cinereus* Latreille, Gen. Crus. Insect., Vol. IV, p. 339; 1809. The

[1] Encyclopédie Méthodique, Vol. X, p. 500; 1828.

following is by Macquart, in Annales Soc. Entomol. France, p. 294; 1845: *Siphona cinerea*[1] Meigen, System. Besch. Eur. Zweif. Ins., Vol. IV, p. 156; 1824. The following is by Rondani in Dipt. Italicæ Prod., Vol. III, p. 10, 1859, and is repeated by Schiner: *Siphona nigroritttata* and *analis* Meigen, System. Besch. Eur. Zweif. Insekten, Vol. IV, p. 157; 1824. *Syphona persilla* Desvoidy, Essai sur les Myod., p. 92; 1830. *Syphona tristis* Desvoidy, Annales Soc. Entomol. France, p. 203; 1850. *Syphona fuscicornis* and *consimilis* Desvoidy, loc. cit., p. 205. The following is by the writer: *Siphona illinoiensis* Townsend, Trans. Amer. Ent. Soc., Vol. XVIII, p. 368; December, 1891.

— *Siphona* sp., Brauer and Bergenstamm *in litt.*)..*geniculata* DeG.

2. Abdomen opaque gray pollinose, black, the sides of the first two segments sometimes partly or wholly yellow, terminal joint of the proboscis at least two-thirds as long as height of head; length, 3 to 4.5 mm. From the type specimen. Southern California. (Canadian Entomologist, Vol. XXVII, p. 125; May, 1895.

— *Siphona* sp., Brauer and Bergenstamm *in litt.*).....*plusiæ* Coq.

Abdomen shining, destitute of pollen, yellow, a dorsal vitta and hind margins of last three segments black; insect elsewhere black, the face, palpi, apex of scutellum, coxæ, femora and tibiæ yellow, apices of femora brown, frontal vitta brownish yellow, antennæ and proboscis yellowish brown, the base and apex of the latter more yellow; terminal joint of proboscis one-half as long as height of head, thorax gray pollinose, not distinctly vittate, scutellum bearing three long marginal pairs and a short apical pair of macrochætæ, last three segments of abdomen bearing only marginal ones; wings hyaline, calypteres whitish; length, 4 mm. Kirkwood, Mo. Three female specimens from Miss M. E. Murtfeldt. Type No. 3574, U. S. National Museum.....*brevirostris* n. sp.

Genus HETEROPTERINA Macq.

Heteropterina Macquart, Annales Soc. Ent. France, p. 426; 1854.

Our species is black, the palpi and usually the base of the antennæ, sides of first three segments of the abdomen, femora, and tibiæ yellow; last three segments of abdomen each marked with a transverse row of five black spots, two of which are on the lateral margins; three postsutural and two sternopleural macrochætæ, scutellum bearing three marginal pairs; length, 3.5 to 5 mm. From the type specimen. Northern Illinois; Colorado, and Los Angeles County, Cal. (Entomological News, Vol. VI, p. 207; April, 1895.)..... .....*nasoni* Coq.

[1] On page 501 of the Encyclopédie Méthodique, Vol. X, 1828, St. Fargeau and Serville propose the name of *Meigeni* for *cinerea* Meigen, which had been previously used in this genus by Latreille, and this name must therefore also be added to the synonymy.

Genus PLAGIPROSPHERYSA Town.

Plagiprospherysa Townsend, Trans. Amer. Ent. Soc., Vol. XIX, p. 113; May, 1892.

Our species is black, the first two joints of the antennæ, palpi, apex of scutellum and sometimes the front corners of the second and third segments of the abdomen, yellow; three postsutural and three sternopleural macrochætæ, two on the front side of each middle tibia near its middle; length, 6 to 9 mm. Georgia; Organ Mountains and Las Cruces, N. Mex., Colorado, Tenino, Wash., and southern California. (Biol. Cent.-Amer., Diptera, Vol. II, p. 124; May, 1890: *Prospherysa. Plagiprospherysa valida* Townsend, Trans. Amer. Ent Soc., Vol. XIX, p. 113; May, 1892. *Plagiprospherysa floridensis* Townsend, loc. cit., p. 114.) ..... *parvipalpis* v. d. W. —

Genus METAPLAGIA Coq.

Metaplagia Coquillett, Journal N. Y. Ent. Soc., Vol. III, p. 102; September, 1895.

Our species is black, the first two joints of the antennæ and the palpi, yellow; three postsutural and three sternopleural macrochætæ; length, 7 mm. From the type specimen. San Diego County, Cal. (Loc. cit., p. 103.) ..... *occidentalis* Coq.

Genus PARAPLAGIA Br. and Berg.

Paraplagia Brauer and Bergenstamm, Zweif. Kais. Mus. Wien, V, p. 354; 1891.

Our two species are black, the first two joints of the antennæ and palpi yellow; three postsutural and three sternopleural macrochætæ:

Third joint of antennæ at most one and one-half times as long as the second, third vein bristly almost to tip of discal cell, first segment of abdomen destitute of macrochætæ; length, 6 to 8 mm. District of Columbia; northern Illinois, and Colorado. (Annales Soc. Entomol. France, p. 262; 1888: *Heteropterina. Paraplagia cinerea* Coquillett, Journal N. Y. Ent. Soc., Vol. III, p. 101; September, 1895.) ..... *spinosula* Bigot. —

Third joint of antennæ three times as long as the second, third vein not bristly to the small crossvein, first segment of abdomen bearing a pair of long macrochætæ; front of female one and one-fifth times as wide as either eye, three pairs of orbital bristles, the median pair small, frontal bristles descending to tip of second antennal joint, sides of face wholly covered with short hairs and each bearing a row of about six macrochætæ, cheeks nearly one-half as broad as the eye height, arista thickened on the basal two-thirds, the penultimate joint one and one-half times as long as broad; thorax thinly gray pollinose, marked with four black vittæ; abdomen white pollinose on bases of last three segments, these bearing discal and marginal macrochætæ; wings hyaline,

calypteres white; length 8 mm. Missouri. A single female specimen bred from an unknown Lepidopterous larva on Triosteum. Type No. 3578, U. S. National Museum.....*crucicola* n. sp.

Genus CYRTOPHLŒBA Rond.

Cyrtophlæba Rondani, Dipterologiæ Italicæ Prodromus, Vol. I, p. 68; 1856.

Our single species is black, with a strong tinge of bronze, the palpi and first two joints of the antennæ yellowish, three postsutural and three sternopleural macrochætæ, second and third abdominal segments bearing discal and marginal ones; length, 7 to 10 mm. Toronto, Canada; New Bedford and Hyde Park, Mass.; Ithaca, N. Y., and northern Illinois. (Journal N. Y. Ent. Soc., Vol. III, p. 101; September, 1895.).....*horrida*[1] Coq.

Genus PLAGIA Meig.

Plagia Meigen, System. Besch. Eur. Zweif. Insekten, Vol. VII, p. 201; 1838

Our species has three postsutural and three sternopleural macrochætæ, proboscis thick, fleshly, less than twice as long as thick, basal half of palpi and the antennæ black, lowest frontal bristles directed downward, third vein at most bristly slightly beyond the small crossvein; length, 7 to 9 mm. Northern Illinois; St. Louis, Mo.; Los Angeles County, Cal.; Allende and Diaz, Mexico. (Biol. Cent.-Amer., Diptera, Vol. II, p. 102; March, 1890. *Plagia aurifrons* Townsend, Canadian Entomologist, Vol. XXIV, p. 67; March, 1892.).....*americana* v. d. W.

Genus SIPHOPLAGIA Town.

Siphoplagia Townsend, Trans. Amer. Ent. Soc., Vol. XVIII, p. 349; November, 1891.

Our species are black, the first two joints of antennæ, lower part of face, cheeks, and palpi, yellow; body subopaque gray pollinose, thorax marked with four black vittæ; three postsutural and three sternopleural macrochætæ, middle tibiæ each bearing four on the front side near the middle, second and third segments of abdomen bearing only marginal macrochætæ; length, 8 mm.:

Fifth vein bare, middle pair of orbital bristles very small. Los Angeles County, Cal. (Trans. Amer. Ent. Soc., Vol. XVIII, p. 350; November, 1891.).....*anomala* Town.

Fifth vein bristly, middle pair of orbital bristles as large as the others. Toronto, Canada, and Colorado. (Biol. Cent.-Amer., Diptera, Vol. II, p. 102; March, 1890: *Plagia*.).....*rigidirostris* v. d. W.

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[1] The *Cyrtophlæba horrida* Giglio-Tos, Boll. Mus. Zool. Torino, Italy, Vol. VIII, p. 6, 1893, does not belong to this genus, since the hind crossvein is nearly perpendicular, the first vein bristly, etc.

Genus DISTICHONA v. d. W.

Distichona van der Wulp, Biologia Cent.-Amer., Diptera, Vol. II, p. 44; Jan., 1890.
Pseudogermaria Brauer and Bergenstamm, Zweif. Kais. Mus. Wien, V, p. 352; 1891.
Olenochæta Townsend, Trans. Amer. Ent. Soc., Vol. XIX, p. 114; May, 1892.

This synonymy is original with the writer. Our two species have four postsutural and four sternopleural macrochætæ, palpi yellow:

Apical cell open; scutellum largely, sides and fourth segment of the abdomen, also the femora and tibiæ, yellow; length, 8 mm. Georgia. (Zweif. Kais. Mus. Wien, V, p. 352; 1891: *Pseudogermaria.*) ..... *georgiæ* Br. and Berg.

Apical cell short petiolate; scutellum, abdomen and legs, black; length, 5 to 8 mm. District of Columbia; Tifton, Ga.; Agricultural College, Miss.; San Diego and Nueces, Tex.; and Las Cruces, N. Mex. (Biol. Cent.-Amer., Dipt., Vol. II, p. 44; January, 1890. *Olenochæta kansensis* Townsend, Trans. Amer. Ent. Soc., Vol. XIX, p. 115; May, 1892.) ..... *varia* v. d. W.

Genus CHÆTOGLOSSA Town.

Chætoglossa Townsend, Trans. Amer. Ent. Soc., Vol. XIX, p. 125; May, 1892.

Our species have three postsutural and three sternopleural macrochætæ, thorax gray pollinose, marked with three broad, black vittæ, wings hyaline, calypteres whitish:

Third joint of antennæ black; black, the second joint of the antennæ yellow; length, 6 mm. Southern Florida. (Loc. cit., p. 126. *Chætoglossa nigripalpis* Townsend, loc. cit.) ..... *violæ* Town.

Third joint of antennæ yellow; black, the antennæ and palpi yellow; length, 6 mm. Southern Florida. (Loc. cit.) ..*picticornis* Town.

Genus PACHYOPHTHALMUS Br. and Berg.

Pachyophthalmus Brauer and Bergenstamm, Zweif. Kais. Mus. Wien, IV, p. 117; 1889.
Sarcomacronychia Townsend, Trans. Amer. Ent. Soc., Vol. XIX, p. 100; May, 1892.

This synonym has already been published by Brauer and Bergenstamm.[1] Our species have the thorax gray pollinose and marked with three black vittæ; three postsutural and two sternopleural macrochætæ:

Fourth segment of abdomen wholly black; black, including the palpi; length, 5 to 8 mm. White Mountains and Franconia, N. H.; New Bedford, Mass.; Berkeley, W. Va.; North Carolina; Centerville, Fla., and Austria. A female from Austria received from Brauer and Bergenstamm and by them labeled *Pachyophthalmus signatus* Meig. (System. Besch. Eur. Zweif. Insekten, Vol. IV, p. 303;

[1]Zweif. Kais. Mus. Wien, VI, p. 195; 1893.

1824: *Tachina*. *Pachyophthalmus aurifrons* Townsend, Trans. Amer. Ent. Soc., Vol. XVIII, p. 354; November, 1891: from a cotype specimen. *Pachyophthalmus* sp., and *Sphixapata* sp., Brauer and Bergenstamm *in litt.*) ..... *signatus* Meig.

Fourth segment of abdomen largely or wholly yellow, insect elsewhere black; length, 5 to 9 mm. Tifton, Ga.; Lake Worth, Fla.; Waco, Tex.; Colorado, and Santa Cruz Mountains and Los Angeles County, Cal. (Entomological News, Vol. III, p. 80; April, 1892. *Sarcomacronychia unica* Townsend, Trans. Amer. Ent. Soc., Vol. XIX, p. 101; May, 1892. *Sarcomacronychia sarcophagoides* Townsend, Canadian Entomologist, Vol. XXIV, p. 165; July, 1892. *Sarcomacronychia trypoxylonis* Townsend, Bulletin Ohio Agr. Exper. Station, Vol. I, No. 3, p. 165; April, 1893.) ..... *floridensis* Town.

Genus SENOTAINIA Macq.

Senotainia Macquart, Diptères Exotiques, Supplement I, p. 167; 1846.
Arrenopus Brauer and Bergenstamm, Zweif. Kais. Mus. Wien, Vol. V, p. 360; 1891.

Our species have three postsutural and two sternoplural macrochætæ, two pairs of orbital bristles in both sexes; thorax, scutellum, and legs, black:

1. Third joint of antennæ black ..... 2.

Third joint of antennæ yellow, last three segments of abdomen gray pollinose on the bases, that on the second and third prolonged to the hind end of the segments in the middle of the dorsum, where it incloses a black triangle; sides of abdomen sometimes partly yellow; length, 4 to 7 mm. Toronto, Canada; New Hampshire; Springfield, Mass.; Maryland; Tifton, Ga.; Georgiana, Fla.; Lexington, Ky.; northern Illinois; Las Cruces, N. Mex., and southern California. (Diptères Exotiques, Supp. I, p. 167; 1846. *Miltogramma erythrocera* Thomson, Kongliga Sven. Fregatten Eugenies Resa, Diptera, p. 523; 1868. *Miltogramma fulvicornis* van der Wulp, Biol. Cent.-Amer., Diptera, Vol. II, p. 89; March, 1890. *Miltogramma flavicornis* Townsend, Trans. Amer. Ent. Soc., Vol. XVIII, p. 355; November, 1891. *Miltogramma similis* Townsend, loc. cit., p. 357. *Miltogramma kansensis* Townsend, Canadian Entomologist, Vol. XXIV, p. 68; March, 1892. *Miltogramma decisa* Townsend, Entomological News, Vol. III, p. 81; April, 1892.) ..... *rubriventris* Macq.

2. Abdomen wholly black ..... 3.

Abdomen yellow, base of the first segment, apex of the fourth, and the genitalia, black, bases of the last three segments white pollinose, abdomen elsewhere shining, second segment destitute of a marginal pair of macrochætæ; sides of front and the face silvery white pollinose, antennæ black; thorax gray pollinose,

the vittæ indistinct; wings hyaline, calypteres white; length, 3 mm. Las Cruces, N. Mex. Two male specimens collected September 17, by Mr. T. D. A. Cockerell. Type No. 3580, U. S. National Museum ..... *nana* n. sp.

3. Second segment of abdomen bearing a distinct marginal pair of macrochætæ, abdomen gray pollinose, usually marked with two or three rows of blackish spots; length, 3 to 6 mm. Toronto, Canada; White Mountains, New Hampshire; Springfield, Mass.; New York City, N. Y.; Maryland; Virginia; North Carolina; Tifton, Ga.; Texas; Colorado; Washington, and southern California. (Biol. Cent.-Amer., Diptera, Vol. II, p. 89; March, 1890: *Miltogramma*. *Arrenopus americana* Brauer and Bergenstamm, Zweif. Kais. Mus. Wien, V, p. 361; 1891. *Miltogramma argentifrons* Townsend, Trans. Amer. Ent. Soc., Vol. XVIII, p. 357; November, 1891. *Miltogramma cinerascens* Townsend, loc. cit., p. 358. *Arrenopus* sp., and *Sphixapata* sp., Brauer and Bergenstamm *in litt.*) ..... *trilineata* v. d. W.

Second segment destitute of a marginal pair of macrochætæ, abdomen shining, bases of last three segments white pollinose; black, the frontal vitta, first two joints of antennæ and the palpi, yellow; sides of front and face white pollinose, thorax whitish pollinose, the vittæ not distinct, wings hyaline, calypteres white; length, 3 mm. Las Cruces, N. Mex. A single male specimen collected September 17 by Mr. T. D. A. Cockerell. Type No. 3581, U. S. National Museum ..... *fasciata* n. sp.

Genus PSEUDOTRACTOCERA Town.

Pseudotractocera Townsend, Trans. Amer. Ent. Soc., Vol. XIX, p. 107; May, 1892.

Our species has three postsutural and three sternopleural macrochætæ, is black, the first two joints of the antennæ and the palpi yellow; apex of antennæ distant from the oral margin the length of the third antennal joint; length, 7.5 mm. From a co-type specimen. Las Cruces, N. Mex. (Loc. cit., p. 108.) ..... *neomexicana* Town.

Genus BIOMYIA Rond.

Fabricia Meigen, System. Besch. Eur. Zweif. Insekten, Vol. VII, p. 250; 1838. (*Non* Blainville; 1828. *Non* Desvoidy; 1830.)
Biomya Rondani, Dipterologiæ Italicæ Prodromus, Vol. I, p. 72; 1856.
Viviania Rondani, loc. cit., Vol. IV, p. 53; 1861.
Masiphya Brauer and Bergenstamm, Zweif. Kais. Mus. Wien, V, p. 313; 1891.

Viviania was proposed for the genus Fabricia of Meigen, the name Fabricia having been previously used by at least two different authors. On the same page Rondani acknowledges that his genus Biomyia is synonymous with Viviania. Specimens identified by Brauer and Bergenstamm as *Masiphya brasiliana*, the type species of this genus, do not possess any character of sufficient importance to warrant its sep-

aration from Biomyia.[1] Our species have only three sternopleural macrochætæ, the second and third segments of the abdomen destitute of discal ones, second joint of antennæ and the palpi, yellow:

1. Thorax bearing only three postsutural macrochætæ ..... 2.
   Thorax bearing four postsutural macrochætæ, middle tibiæ each bearing only one on the front side near the middle, scutellum and sides of first three segments of the abdomen black, apex of the fourth segment yellow, antennæ two-thirds as long as the face; length, 11 mm. Florida. (Proc. Acad. Nat. Sci. Philadelphia, p. 309; September, 1895: *Masiphya.*) ..... *aurigera* Coq.
2. Antennæ at least three-fourths as long as the face; scutellum and abdomen wholly black ..... 3.
   Antennæ two-thirds as long as the face, middle tibiæ each bearing two or more macrochætæ on the front side near the middle; apex of scutellum and sides and apex of abdomen yellow; length, 9 to 12 mm. District of Columbia; Maryland; Virginia; Tifton, Ga.; Biscayne Bay, Fla., and Los Angeles Co., Cal. (Zweif. Kais. Mus. Wien, V, p. 313; 1891: *Masiphya.* Also *in litt. Tachinomyia floridensis* Townsend, Trans. Amer. Ent. Soc., Vol. XIX, p. 97; May, 1892.) ..... *brasiliana* Br. and Berg.
3. Cheeks one-fifth as broad as the eye height, front in each sex one-half as wide as either eye, abdomen subopaque gray pollinose, hind margins of the second and third segments and reflecting spots darker; length, 5 to 6 mm. Amherst, Mass., and Los Angeles County, Cal. (Zweif. Kais. Mus. Wien, V, p. 312; 1891: *Viviania. Masicera sordicolor* Townsend, Trans. Amer. Ent. Soc., Vol. XVIII, p. 359; December, 1891. *Pseudotractocera calosomæ* Coq. MS., Burgess in Rept. Mass. State Board Agric., p. 83; January, 1897.) ..... *georgiæ* Br. and Berg.
   Cheeks one-tenth as broad as the eye height, front of female as wide as either eye; black, the palpi and apex of proboscis yellow; frontal bristles descending almost to apex of the second antennal joint, five pairs of orbital bristles in the female, sides of face at narrowest part each one-tenth as wide as the median depression, vibrissæ half the length of the second antennal joint above the oral margin, ridges bristly on the lowest fourth, antennæ reaching slightly below lowest third of face, the third joint one and one-half times as long as the second, arista thickened almost to the middle, the penultimate joint as broad as long; thorax thinly gray pollinose, marked with four black vittæ, scutellum bearing three long marginal pairs of macrochætæ, abdomen

[1] An Austrian specimen received from Brauer and Bergenstamm and by them labeled *Viviania pacta* Meig., has the apical cross vein strongly concave, and not straight, as stated by these authors in Zweif. Kais. Mus. Wien, VI, p. 111; 1893.

subshining, last three segments lightly grayish pollinose except their apices, each segment bearing marginal macrochaetæ, wings hyaline, base of third vein bearing three bristles near the base, apical cell closed and very short petiolate, ending slightly before the extreme wing tip; calypteres whitish; length, 4 mm. Tifton, Ga. A single female specimen collected in June, 1896, by Mr. G. R. Pilate. Type No. 3582, U. S. National Museum. *genalis* n. sp

Genus ATACTA Schiner.

Atacta Schiner, Reise der Fregatte Novara, Diptera, p. 328; 1868.

Our single species is black, the apex of the scutellum yellowish, the fourth segment of the abdomen wholly golden yellow; front of male less than one-third as wide as either eye, the sides bluish-gray pollinose and thickly covered with short suberect hairs, frontal bristles descending nearly to middle of second antennal joint, cruciate except the vertical pair; cheeks one-fourth as wide as the eye-height, face yellow pollinose, the ridges broadly bordered internally with black, sides of face at narrowest part one-third as wide as the median depression, vibrissæ situated two-thirds the length of the second antennal joint above the level of front edge of oral margin, ridges bristly on the lowest fifth, antennæ two-thirds as long as the face, the third joint slightly longer than the second, arista thickened on the basal two-fifths, the penultimate joint broader than long; thorax gray pollinose, marked with four black vittæ, four postsutural and four sternopleural macrochaetæ, scutellum bearing three pairs of long marginal; abdomen gray pollinose on the first three segments, the first two destitute of dorsal macrochaetæ, the last two each bearing a marginal row; front pulvilli as long as the last tarsal joint, middle tibiæ each bearing four or more macrochaetæ on the front side near the middle; wings hyaline, third vein bearing two or three bristles near the base, calypteres white; length, 12 mm. Tifton, Ga. A single male specimen collected September 28, 1896, by G. R. Pilate. Type No. 3583, U. S. National Museum..... *apicalis* n. sp.

Genus SIPHOSTURMIA, new genus.

The principal characters of this genus have been given in the table of genera on previous pages. The type species is black, the first two joints of antennæ, lower part of face, palpi, scutellum, apex of abdomen, and sometimes the sides, yellow; four postsutural and four sternopleural macrochaetæ, two or more on front side of each middle tibia near the middle, marginal ones on the first three, or the second and third, segments of abdomen; length, 10.5 mm. Tifton, Ga., and Florida. (Journal N. Y. Ent. Soc., Vol. III, p. 106; September, 1895: *Argyrophylax.*) ..... *rostrata* Coq.

Genus BELVOSIA Desv.

Belvosia Desvoidy, Essai sur les Myodaires, p. 103; 1830.
Latreillia Desvoidy, loc. cit., p. 104. (*Non* Roux; 1827.)
Willistonia Brauer and Bergenstamm, Zweif. Kais. Mus. Wien, IV, p. 97; 1889.

The identity of Belvosia and Latreillia has been acknowledged by several authorities; and Brauer and Bergenstamm state[1] that the latter (the name of which is preoccupied in the Crustacea) is a subgenus of Willistonia. Our species have four postsutural and four sternopleural macrochætæ:

1. Third abdominal segment yellowish pollinose except apically, wings brownish ..... 2.

   Third segment destitute of yellowish pollen, abdomen gray pollinose except on the fourth segment, which is yellow pollinose, frontal vitta yellow, wings hyaline; length, 10 to 12 mm. Massachusetts; Ithaca and New York, N. Y.; Chicago, Ill.; Tifton, Ga.; and Mississippi. (Essai sur les Myodaires, p. 105; 1830: *Latreillia. Exorista flavicauda* Riley, Second Rept. Ins. Missouri, p. 51; 1870: from the type specimen.) ..*unifasciata* Desv.

2. Sides of face at narrowest part each one-third as wide as the median depression, frontal vitta yellow, abdomen black, bases of last three segments yellowish gray pollinose; length, 11 mm. Charlotte Harbor, Florida. (Proc. Acad. Nat. Sciences Phila., p. 312; September, 1895.) ..... *slossonæ* Coq.

   Sides of face at narrowest point each more than one half as wide as median depression, frontal vitta dark brown, abdomen black, the last two segments except their apices yellowish pollinose, base of the second sometimes also narrowly yellowish pollinose; relation of second and third antennal joint varies as follows: female, third joint $1\frac{1}{2}$, $1\frac{3}{4}$, 2, $2\frac{1}{2}$ times as long as the second; male, third joint $2\frac{1}{4}$, 3, $3\frac{1}{2}$, and 4 times as long as the second; facial ridges bristly in female $\frac{1}{3}$, $\frac{2}{5}$, and $\frac{2}{3}$, in male $\frac{2}{3}$ to $\frac{3}{4}$ distance above the vibrissæ; length, 13 to 17 mm. Springfield, Mass.; District of Columbia; North Carolina; Tifton, Ga.; Mississippi; St. Louis, Mo.; Illinois; Los Angeles Co., Cal.; Waco, Tex., and Mexico. (Systema Entomologiæ, p. 777; 1775: *Musca. Belvosia bicincta* Desvoidy, Essai sur les Myod., p. 103; 1830. *Latreillia bifasciata* F., Brauer and Bergenstamm *in litt.*) ..*bifasciata* Fabr.

[1] Zweif. Kais. Mus. Wien, VI, p. 213; 1893.

Genus MELANOPHRYS Will.

Melanophrys Williston, Trans. Amer. Ent. Soc., Vol. XIII, p. 305; November, 1886.
Atropharista Townsend, Trans. Amer. Ent. Soc., Vol. XIX, p. 92; April, 1892.

Mr. Townsend has already acknowledged this synonymy.[1] Our species are black, the arista and usually the palpi and calypteres yellow, bases of wings strongly tinged with yellow; three postsutural and three sternopleural macrochætæ:

Second abdominal segment bearing a marginal pair of macrochætæ, the third segment bearing a marginal row of from six to eight; length, 14 mm. Los Angeles County, Cal. (Trans. Amer. Ent. Soc., Vol. XIII, p. 306; November, 1886.) ..... *flavipennis* Will.

Second segment destitute of a marginal pair of macrochætæ, the third usually bearing a dorsal pair and a single lateral one each side; length, 12 to 14 mm. Grimsby, Canada; Franconia and White Mountains, New Hampshire; northern Illinois, and Colorado. (Insecta Saundersiana, Vol. I, p. 277; 1856: *Tachina. Atropharista jurinoides* Townsend, Trans. Amer. Ent. Soc., Vol. XIX, p. 92; April, 1892. *Melanophrys flavipennis* Will., Brauer and Bergenstamm *in litt.*) ..... *insolita* Walk.

Genus APHRIA Desv.

Aphria Desvoidy, Essai sur les Myodaires, p. 89; 1830.
Olivieria Meigen, Systematische Besch. Eur. Zweif. Insekten, Vol. VII, p. 266; 1838. (*Non* Desvoidy, Essai sur les Myod., p. 228; 1830.)
Rhynchosia Macquart, Annales Soc. Ent. France, p. 87; 1848.

Macquart (loc. cit.) proposed the name Rhynchosia for the genus to which Meigen had given the name of Olivieria, owing to the fact that Desvoidy had previously used the latter name for an entirely different genus. The synonymy of Rhynchosia and Aphria was first pointed out by Rondani,[2] and is repeated by Schiner[3] and also by Brauer and Bergenstamm.[4] Our single species is black, the frontal vitta, the first two joints of the antennæ usually, the palpi, and sides of abdomen largely, yellowish; male destitute of orbital bristles; three postsutural and three sternopleural macrochætæ; length, 6 to 10 mm. Toronto, Canada; Massachusetts; Atco, N. J.; Georgia; northern Illinois; Colorado; Washington, and southern California. (Trans. Amer. Ent. Soc., Vol. XVIII, p. 361; December, 1891. *Aphria* sp., Brauer and Bergenstamm *in litt.*) ..... *ocypterata* Town.

[1] Trans. Amer. Ent. Soc., Vol. XXII, p. 72; March, 1895.
[2] Dipterologiæ Italicæ Prodromus, Vol. I, p. 73; 1856.
[3] Fauna Austriaca, Vol. I, p. 432; 1862.
[4] Zweif. Kais. Mus. Wien, VI, p. 237; 1893.

Genus OCYPTERA Latr.

Ocyptera Latreille, Histoire Nat. Crust. et Insectes, Vol. XIV, p. 378; 1804.
Parthenia Desvoidy, Essai sur les Myodaires, p. 231; 1830.

This synonymy is given by Schiner[1] and repeated by Brauer and Bergenstamm.[2] Our species have three postsutural and two or three sternopleural macrochætæ:

1. Scutellum bearing one pair of long marginal and sometimes a short apical pair of macrochætæ ..... 2.

   Scutellum bearing two pairs of long marginal and a short apical pair of macrochætæ; abdomen black, the sides of the second and third segments partly or wholly reddish yellow; length, 8 to 12 mm. Canada; Springfield, Mass.; Connecticut; Cape May, N. J.; Maryland; Tifton, Ga.; Selma, Ala.; Tennessee; Lexington, Ky.; Michigan; Illinois; Cadet, Mo.; Kansas; Colorado; Santa Cruz Mountains and Los Angeles County, Cal. (Essai sur les Myodaires, p. 232; 1830: *Parthenia*. *Ocyptera dotades* Walker, List of Dipterous Insects, Part IV, p. 694; 1849. *Ocyptera epytus* Walker, loc. cit. *Ocyptera euchenor* Walker, loc. cit., p. 696. *Ocyptera californica* Bigot, Annales Soc. Entomol. France, p. 42; 1878. *Ocyptera fumipennis* Bigot, loc. cit., p. 43. *Ocyptera binotata* Bigot, loc. cit., p. 44. *Ocyptera* sp., Brauer and Bergenstamm *in litt.*) ..... *carolinæ* Desv.

2. With a short apical pair of macrochætæ on the scutellum; abdomen black, the front corners of the third segment sometimes faintly reddish; length .7 to 8 mm. Westville, N. J.; Delaware County, Pa.; northern Virginia; and Missouri. (Proc. Ent. Soc. Washington, Vol. II, p. 144; April 2, 1891.) ..... *argentea* Town.

   Without an apical pair of macrochætæ on the scutellum; abdomen black, the sides of the second and front corners of the third segment reddish yellow; length, 7 to 10 mm. White Mountains, New Hampshire; Horseneck Beach, Mass.; northern Illinois; Georgia; Louisiana; Texas; and Reno, Nev. (List of Dipterous Insects, Part IV, p. 695; 1849. *Ocyptera* sp., Brauer and Bergenstamm *in litt.*) ..... *dosiades* Walk.[3]

Genus LINNÆMYIA Desv.

Linnæmya Desvoidy, Essai sur les Myodaires, p. 52; 1830.
Bonnetia Desvoidy, loc. cit., p. 55.
Bonellia Desvoidy, loc. cit., p. 56.
Marshamia Desvoidy, loc. cit., p. 57.
Micropalpus Macquart, Historie Nat. Insectes, Diptères, Vol. II, p. 80; 1835.

The author last mentioned referred the above four names of Desvoidy to one genus to which he applied the name of Micropalpus, but the law

[1] Fauna Austriaca, Vol. I, p. 412; 1862.
[2] Zweif. Kais. Mus. Wien, VI, p. 235; 1893.
[3] *Ocyptera litturata* Olivier belongs to the Dexid genus Euantha, and is the same species which Wiedemann afterwards described as *Dexia dives*.

of priority compels us to adopt the oldest name. Our species have three postsutural and three sternopleural macrochaetæ; front tarsi of female as broad as the apex of the front tibiæ, in the male much narrower:

Cheeks bearing black macrochaetæ in the centers, frontal vitta black or dark brown, male destitute of orbital bristles, his genitalia at most projecting one-fifth the length of the fourth abdominal segment beyond the latter, hind crossvein bent nearly S-shape; length, 11 mm. White Mountains, New Hampshire; Beverly, Mass., and Austria. Two males and one female from Austria received from Brauer and Bergenstamm and by them named *Micropalpus hæmorrhoidalis* Fall. and *Micropalpus pudicus* Rond., but both names are evidently wrong, since the male of *hæmorrhoidalis* is provided with orbital bristles, and *pudicus* has no black macrochaetæ on the center of the cheeks. (System. Besch. Eur. Zweif. Insekten, Vol. IV, p. 261; 1824: *Tachina.*) . . . . . *picta* Meig.

Cheeks destitute of black macrochaetæ near the centers, frontal vitta light yellow, male provided with two pairs of orbital bristles, his genitalia projecting nearly half the length of the fourth abdominal segment beyond the latter, hind crossvein nearly straight; length, 9 to 12 mm. London, Canada; Maryland; District of Columbia; Texas; Santa Fe, N. Mex.; California, and Pullman, Wash. (Kongl. Svenska. Vetensk. Akad. Handlinger, Vol. XXXI; 1810: *Tachina. Tachina fulgens*[1] Meigen, System. Besch. Eur. Zweifl. Insekten, Vol. IV, p. 259; 1824. *Linnæmya heraclæi* Desvoidy, Essai sur les Myodaires, p. 53; 1830. *Linnæmya analis* Desvoidy, loc. cit., p. 54. *Linnæmya distincta* Desvoidy, loc. cit. *Linnæmya æstivalis* Desvoidy, loc. cit. *Linnæmya borealis* Desvoidy, loc. cit. *Marshamia analis* Desvoidy, loc. cit., p. 58. *Marshamia nigripes* Desvoidy, loc. cit. *Micropalpus piceus* Macquart, Hist. Natur. Insectes, Diptères, Vol. II, p. 84; 1835. *Micropalpus* sp., Brauer and Bergenstamm *in litt.*) . . . . . *comta* Fallen.

Genus **NEMORÆA** Desv.

Nemoræa Desvoidy, Essai sur les Myodaires, p. 70; 1830.

Our single species is black, the antennæ, palpi, and fourth abdominal segment except its extreme apex, yellow; three postsutural and three

[1] Meigen did not recognize *comta*, and therefore unknowingly redescribed it under the name of *fulgens;* this was suspected by Zetterstedt (Dipt. Scand., Vol. III, p. 1097; 1844) and given as certain by Rondani (Dipt. Ital. Prod., Vol. III, p. 70; 1859). The *comtus* of Schiner, Fauna Austriaca, Vol. I, p. 429, is not that species, but a color variety of *hæmorrhoidalis;* the species he describes under *fulgens* is the true *comtus*. In the Annales Soc. Ent. France for 1844, page 31, Desvoidy acknowledges that his *Linnæmya heraclæi, analis,* and *æstivalis* belong to one species, and in the same serial for 1845, page 271, Macquart adds *borealis* to this list and refers them to *fulgens*. The name of *Micropalpus piceus* was proposed by Macquart to take the place of *Marshamia analis* Desvoidy. The writer is responsible for the synonymy of *piceus, distincta* and *nigripes*.

sternopleural macrochaetæ, scutellum bearing three long marginal pairs, a distinct brown cloud on the small crossvein; length, 8.5 mm. From the type specimen. Washington. (Jour. N. Y. Ent Soc., Vol. III, p. 104; September, 1895.) ..... *labis* Coq.

Genus PANZERIA Desv.

Panzeria Desvoidy, Essai sur les Myodaires, p. 68; 1830.
Ernestia Desvoidy, loc. cit., p. 60.
Fausta Desvoidy, loc. cit., p. 62.
Erigone Desvoidy, loc. cit., p. 65. (*Non* Savigny, 1827.)

This synonymy has been given by various authors, and, with the exception of Erigone, is repeated by Brauer and Bergenstamm. Erigone they retain as a distinct genus, but the name is preoccupied in the Arachnida, and the species they place in it are too closely allied to Panzeria to be separated generically. Our species have three sternopleural macrochaetæ, and the small crossvein is not clouded with brown:

Scutellum bearing three pairs of long marginal macrochaetæ besides the apical pair; body very robust, front tarsi of female greatly dilated, usually four but sometimes only three postsutural macrochaetæ; coloring variable, the second antennal joint, palpi, apex of scutellum and of abdomen usually yellow but sometimes black; length, 7 to 11 mm. Mount Washington and Franconia, N. H.; New Bedford, Mass.; Riverview, Md.; District of Columbia; St. Louis, Mo.; Waco, Tex.; Brookings, S. Dak.; Colorado; San Francisco, Cal.; Olymphia, Wash.; British Columbia; Bohemia, Austria; Germany, and England. A male from Austria received from Brauer and Bergenstamm, and by them labeled *Erigone radicum* Fabr.; two males and one female from Germany, received from Zeller and by him labeled *Nemoræa radicum;* also a male from England received from Brunetti and by him labeled like the last. (Systema Entomologiæ, p. 778; 1775: *Musca.* The following synonymy is given by Schiner, Fauna Austriaca, Vol. I, p. 452: *Erigone anthophila* Desvoidy, Essai sur les Myodaires, p. 66; 1830. *Erigone scutellaris* Desvoidy, loc. cit. *Erigone puparum* Desvoidy, loc. cit. *Erigone viridulans* Desvoidy, loc. cit., p. 68. *Erigone dubia* Desvoidy, loc. cit. *Nemoræa minor* Macquart, Annales Soc. Ent. France, Vol. VI, p. 112; 1848. The following is original with the writer: *Tachina ampelus* Walker, List of Dipterous Insects, Part IV, p. 732; 1849. *Hystricia aldrichi* Townsend, Trans. Amer. Ent. Soc., Vol. XIX, p. 91; April, 1892: from a cotype specimen. *Erigone* sp. Brauer and Bergenstamm *in litt.*) ..... *radicum* Fabr.

Scutellum bearing only two pairs of long marginal macrochaetæ besides the apical pair; body slender, front tarsi of female not dilated; black, including the palpi; front of male three fifths as wide as, in the female slightly wider than, either eye, two pairs

of orbital bristles in the female, none in the male, frontal bristles descending below middle of second antennal joint, cheeks one-fourth as wide as the eye height, facial ridges bristly on the lowest fourth, antennæ four-fifths as long as the face, the third joint one and one-half times as long as the second, arista thickened on the basal fourth, the penultimate joint shorter than broad; thorax gray pollinose, marked with three black vittæ, three postsutural macrochætæ; abdomen thinly gray pollinose and with blackish reflecting spots, last three segments bearing discal and marginal macrochætæ; middle tibiæ each bearing two or more macrochætæ on the front side near the middle, front pulvilli of male as long as the last tarsal joint; wings hyaline, third vein bearing one or two bristles near the base; calypteres white; length, 9 mm. Norfolk, Va., and Kirkwood, Mo. Four males and two females. Type No. 3586, U. S. National Museum. . *penitalis* n. sp.

Genus MACROMEIGENIA Br. and Berg.

Macromeigenia Brauer and Bergenstamm, Zweif. Kais. Mus. Wien, V, p. 311; 1891.

The type species is black, the first two antennal joints, palpi, and fourth abdominal segment, except sometimes its base, yellow; four postsutural and three sternopleural macrochætæ; length, 11 to 14 mm. Northern Virginia and Tifton, Ga. (Ausser. Zweif. Insekten, Vol. II, p. 309; 1830: *Tachina*. *Tachina interrupta* Walker, Insecta Saundersiana, Vol. I, p. 295; 1856.) . . . . . *chrysoprocta* Wied.

Genus GYMNOCHÆTA Desv.

Gymnochæta Desvoidy, Essai sur les Myodaires, p. 371; 1830.

Body, occiput, and sides of front green, antennæ and legs black; sometimes the third antennal joint is yellow, and rarely the entire antennæ is yellow; palpi yellow, frontal bristles in single rows; length, 10 to 12 mm. Newark, N. J., and Colorado. (Diptera Amer. Sept. Indigena, Cent. VIII, No. 61; 1869. *Gymnochæta ruficornis* Williston, Trans. Amer. Ent. Soc., Vol. XIII, p. 302; October, 1886. . . *aleedo* Loew.

Unrecognized species.—G. vivida Williston, Trans. Amer. Ent. Soc., Vol. XIII, p. 302; October, 1886. Pa.

Genus METAPHYTO, new genus.

The characters of this genus may be gleaned from the above table of genera and the following description of the type species: Black, the apex of the scutellum yellowish; front of female one and one-third times as wide as either eye, two pairs or orbital bristles, frontals descending to middle of second antennal joint, vibrissæ slightly above the level of front edge of oral margin, two or three bristles above each, antennæ nearly four-fifths as long as the face, the third joint one and

one-third times as long as the second, arista thickened on the basal half, the penultimate joint scarcely longer than wide; thorax thinly gray pollinose, marked with four black vittæ, three postsutural and three sternopleural macrochætæ, scutellum bearing four marginal pairs, abdomen thinly gray pollinose on the last three segments, which bear marginal macrochætæ; front tarsi noticeably dilated; middle tibiæ each bearing three or more macrochætæ on the front side near the middle, hind tibiæ not ciliate outwardly; wings hyaline, the base yellow, third vein bearing three or four bristles near the base, bend of fourth vein angular and bearing a stump about as long as the small crossvein, the vein beyond it strongly arcuate, hind crossvein near last fourth of distance from the small to the bend; calypteres white; length, 9 mm. Colorado. Two female specimens collected by Mr. Carl F. Baker. Type No. 3587, U. S. National Museum.....*genalis* n. sp.

Genus EXORISTOIDES, new genus.

The characters of this genus, of which *johnsoni* is the type species, may be gleaned from the table of genera on preceding pages of this work and from the description of this species given below:

Third joint of antennæ concave on the front edge, three or four sternopleural macrochætæ, apex of scutellum and of abdomen black; black, the palpi, and sometimes the base of the third antennal joint, yellow; front in male three-fourths as wide as, in the female slightly wider than, either eye, two pairs of orbital bristles in the female, wanting in the male, frontal bristles descending to the arista, cheeks one-fourth as wide as the eye height, vibrissæ on a line with front edge of oral margin, two or three bristles above each, antennæ almost as long as the face, the third joint in the male five, in the female two and one-third, times as long as the second, arista thickened on the basal two-fifths to three-fifths, the penultimate joint slightly longer than broad; thorax gray pollinose, marked with four black vittæ, three postsutural macrochætæ, scutellum bearing three long marginal pairs and a short apical pair; abdomen thinly gray pollinose and with reflecting darker spots, last three segments bearing discal and marginal macrochætæ; middle tibiæ bearing three or more on the front side of each near the middle, front tarsi of female greatly dilated, front pulvilli of male almost as long as the last tarsal joint; wings hyaline, first vein bearing two or more bristles on the outer half, third vein bristly almost to the small crossvein, bend of fourth vein almost rectangular, destitute of an appendage, vein beyond the bend strongly arcuate, hind crossvein nearly straight, slightly beyond middle between the small and the bend; calypteres white; length, 6 to 7 mm. Eastport, Me.; Franconia, N. H.; Westville and Clementon, N. J. Three males and three females, collected May 30 and July

21, 1895, by Mrs. A. T. Slosson and Mr. C. W. Johnson. Type No. 3588, U. S. National Museum. (*Somoleja* sp., Brauer and Bergenstamm *in litt.*) ..... *slossonæ* n. sp.

Third joint of antennæ strongly convex on the front edge, two sternopleural macrochætæ, apex of scutellum and of abdomen, first two joints of antennæ and base of the third yellow; frontal bristles descending to apex of second antennal joint, cheeks two-fifths as broad as the eye height; first vein bristly on one-fourth of its length near the middle, the third bristly almost or slightly over halfway to the small crossvein; length, 9 mm.; otherwise as in above description of *slossonæ*. Hertford County, N. C., and Reno, Nev. Two female specimens; one collected June 9, 1895, by Mr. C. W. Johnson, the other by Mr. H. F. Wickham. Type No. 3589, U. S. National Museum ..... *johnsoni* n. sp.

Genus HYPHANTROPHAGA Town.

Hyphantrophaga Townsend, Psyche, Vol. VI, p. 247; April, 1892.

Our single species is black, the first two joints of the antennæ, palpi, and apex of proboscis yellow; four postsutural and three sternopleural macrochætæ, middle tibiæ each bearing a single macrochæta on the front side near the middle, hind tibiæ outwardly subciliate, second and third segments of abdomen bearing only marginal, the fourth with discal and marginal macrochætæ; length, 7 mm. From a cotype specimen. Las Cruces, N. Mex. (Psyche, Vol. VI, p. 176; November, 1891: *Meigenia.*) ..... *hyphantriæ* Town.

Genus EXORISTA Meig.

Exorista Meigen, in Illiger's Magazin für Insektenkunde, Vol. II, p. 280; 1803.
Lydella Desvoidy, Essai sur les Myodaires, p. 112; 1830.
Phryno Desvoidy, loc. cit., p. 143.
Phryxe Desvoidy, loc. cit., p. 158.
Carcelia Desvoidy, loc. cit., p. 176.
Aplomya Desvoidy, loc. cit., p. 184.
Eurygaster Macquart, Histoire Naturelle Diptères, Vol. II, p. 115; 1835.
Hubneria Desvoidy, Annales Soc. Ent. France, p. 601; 1847.
Nemorilla Rondani, Dipterologiæ Italicæ Prodromus, Vol. I, p. 66; 1856.
Blepharidea Rondani, loc. cit., p. 67.
Aporomya Rondani, loc. cit., Vol. III, p. 90; 1859.
Parexorista Brauer and Bergenstamm, Zweif. Kais. Mus. Wien, IV, p. 87; 1889.
Sisyropa Brauer and Bergenstamm, loc. cit., p. 163.
Myxexorista Brauer and Bergenstamm, loc. cit., V, p. 331; 1891.

Rondani places Eurygaster as a synonym of Exorista,[1] and in this he is followed by Schiner,[2] while Brauer and Bergenstamm give this synonymy as probable.[3] Schiner also gives Lydella, Phryno, Carcelia,

[1] Dipterologiæ Italicæ Prodromus, Vol. III, p. 115; 1859.
[2] Fauna Austriaca, Vol. I, p. 457; 1862.
[3] Zweif. Kais. Mus. Wien, VI, Index; 1893.

Hubneria, and Aporomyia as synonyms of Exorista, and Brauer and Bergenstamm make all of them (with the exception of Aporomyia) synonyms of Parexorista, placing the latter and Nemorilla as subgenera of Exorista. Aporomyia they place in a separate section, Polidea, but an examination of a specimen received from them under the name of *Aporomyia dubia*, the species upon which Rondani founded this genus, proves that it should not be separated from Exorista. Blepharidea, Sisyropa, and Myxexorista they place in as many different sections, even putting Blepharidea in two sections, once in the section Masicera and a second time in the section Phorocera. A careful examination of specimens referred by these authors to these three genera failed to reveal a single generic character for separating them from each other or from typical species of Exorista. Moreover, of four specimens of *Exorista cubyæ* submitted to these authors by Dr. Riley, two of the specimens were referred by them to Sisyropa and two to Myxexorista; and of three specimens of *Exorista flavirostris*, two were referred by them to Sisyropa and the remaining specimen to Myxexorista. These authors give Phryxe as a synonym of Blepharidea.

Our species of Exorista are as follows:

1. Second and third segments of abdomen bearing discal as well as marginal macrochætæ ..... 2.
   Second and third segments destitute of discal macrochætæ ..... 14.
2. With three sternopleural macrochætæ ..... 5.
   With only two sternopleural macrochætæ, male destitute of orbital bristles, hind tibiæ outwardly ciliate, apical cell open ..... 3.
3. Thorax bearing four postsutural macrochætæ, palpi partly or wholly yellow ..... 4.
   Thorax bearing only three postsutural macrochætæ, scutellum black, hairs of abdomen short, depressed, middle tibiæ each bearing a single macrochæta on the front side near the middle; palpi yellow, front in the male one-half, in the female five-sixths, as wide as either eye, third joint of antennæ three and one-half times as long as the second; length, 6 to 9 mm. Franconia, N. H.; Philadelphia, Pa., and northern Illinois. (Canadian Entomologist, Vol. XIX, p. 162; Sept., 1887.) ..... *blanda* O. S.
4. Scutellum yellow, hairs of abdomen rather long and subercct, middle tibiæ each bearing two or more macrochætæ on the front side near the middle, front in the male one-half, in the female five-sixths, as wide as either eye, third joint of antennæ two and one-half times as long as the second; length, 8 to 10 mm. Franconia, N. H., Michigan, Tennessee, Georgia, California, and Austria. A female specimen from the Schiner collection, received from Brauer and Bergenstamm under the name of *Parexorista chelonia* Rond. (Dipt. Italicæ Prod., Vol. III, p. 120; 1859. *Sisyropa* sp., Brauer and Bergenstamm *in litt.*) ... *chelonia* Rond.

Scutellum black, middle tibiæ each bearing a single macrochæta on the front side near the middle, front in the male two-thirds, in the female five-sixths, as wide as either eye, third joint of antennæ one and one-half times as long as the second; length, 5 to 8 mm. Franconia, N. H.; Beverly, Mass.; District of Columbia; Charleston, S. C.; Biscayne Bay, Fla.; Oxford, Ind.; Moselle, Mo.; Tiger Mills, Tex.; Colorado, and Allende, Mexico. (List of Dipterous Insects, Part IV, p. 754; 1849: *Tachina. Tachina* [*Exorista*] *phycitæ* LeBaron, Second Report Insects Illinois, p. 123; 1872. *Exorista scudderi* Williston, in Scudder's Butterflies of New England, Vol. III, p. 1921; 1889. *Nemorilla* sp., Brauer and Bergenstamm *in litt.*) ..... *pyste* Walk. —

5. Palpi yellow ..... 7.

Palpi black, four postsutural macrochætæ, scutellum usually yellow, middle tibiæ each bearing two or more macrochætæ on the front side near the middle, hind tibiæ outwardly ciliate, apical cell open, male destitute of orbital bristles ..... 6.

6. Front in both sexes one and one-fourth times as wide as either eye, third joint of antennæ in the male four, in the female two and one-fourth, times as long as the second, arista thickened to the middle; length, 7 to 8 mm. White Mountains and Franconia, N. H.; Olympia, Wash.; England, and Austria. One female from England received from E. Brunetti and by him named *Exorista vulgaris;* also two males and one female from Austria, from Brauer and Bergenstamm and named by them *Blepharidea vulgaris* Fall. (Kongl. Svenska Vetensk. Akad. Handlinger, Vol. XXXI; 1810: *Tachina.* The following synonymy is given by Rondani[1] and repeated by Schiner:[2] *Lydella scutellaris* Desvoidy, Essai sur les Myodaires, p. 115; 1830. *Exorista distans* Macquart, Annales Soc. Entomol. France, p. 387; 1849. *Exorista audax* Macquart, loc. cit., p. 388. *Exorista florida* Macquart, loc. cit., p. 409. The following synonymy is by the writer: *Tachina* [*Exorista*] *hirsuta* Osten Sacken, Canadian Entomologist, Vol. XIX, p. 163; September, 1887. *Blepharidea ?hirsuta* O. S., Brauer and Bergenstamm *in litt.*) ..... *vulgaris* Fallen. —

Front in the male one-half, in the female three-fourths, as wide as either eye; third joint of antennæ in the male two and one-half, in the female one and one third, times as long as the second; arista thickened on the basal third; length, 5 to 8 mm. Toronto, Can.; Franconia, N. H.; Dist. Columbia; Illinois, and southern Cal. (Psyche, Vol. VII, p. 330; Jan., 1896.) .. *nigripalpis* Town. —

7. Thorax bearing four postsutural macrochætæ, apical cell open . 11.

Thorax bearing only three postsutural macrochætæ ..... 8.

8. Middle tibiæ each bearing two or more macrochætæ on the front side near the middle ..... 9.

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[1] Dipterologiæ Italicæ Prodromus, Vol. III, p. 140; 1859.

[2] Fauna Austriaca, Vol. I, p. 458; 1862.

Middle tibiæ each bearing a single macrochæta on the front side near the middle; scutellum black; apical cell open; front in the female three fourths as broad as either eye; face, white pollinose; third joint of antennæ three times as long as the second; length, 6 mm. Franconia, N. H.; Georgia; Missouri, and Texas. (Biol. Cent. Amer., Dipt., Vol. II, p. 64; Feb., 1890.) . . *ordinaria* v. d. W.

9. Scutellum largely yellow, front bearing numerous short, nearly erect hairs, third vein bearing two bristles near the base, apical cell open, front in the male two-thirds, in the female five-sixths, as wide as either eye, third joint of antennæ in the male two and one-fourth, in the female one and three-fourths, times as long as the second; length, 6 to 8 mm. Toronto, Canada; Franconia, N. H.; Summit County, Colo.; Germany, and Austria. Two females from Germany received from Zeller and by him named *Exorista affinis;* also one female from Austria from the old Schiner collection, received from Brauer and Bergenstamm and by them named *Parexorista polychæta* Macq.[1] (Kongl. Svenska Vetensk. Akad. Handlinger, Vol. XXXI; 1810: *Tachina. Exorista polychæta* Macquart, Annales Soc. Entomol. France, p. 380; 1849. *Tachina epicydes* Walker, List of Dipterous Insects, Part IV, p. 786; 1849. *Parexorista* sp., Brauer and Bergenstamm *in litt.*) . . . . . *affinis* Fallen.

Scutellum black, hairs of front short and inconspicuous, front in the female five sixths as wide as either eye, the third antennal joint two and one-half times as long as the second . . . . . 10.

Scutellum black except the tip, third joint of antennæ five times as long as the second; black, the palpi and extreme tip of scutellum yellow; front of female as wide as either eye, hairs on its sides sparse but rather long, frontal bristles descending almost to base of third antennal joint, sides of face white pollinose, cheeks one seventh as wide as the eye height, antennæ almost as long as the face, arista thickened on the basal third, the penultimate joint shorter than broad; thorax gray pollinose and marked with four black vittæ; scutellum bearing four marginal pairs of macrochætæ, the last pair cruciate and directed backward; abdomen subshining, the last three segments gray pollinose except on their apices, the bristly hairs rather long and subdepressed; wings hyaline, third vein bearing two bristles near the base, the fourth strongly arcuate beyond the bend, calypteres whitish; length, 8 mm. University, North Dakota. A single female specimen collected in June, 1896, by Mr. R. P. Currie. . . *curriei* n. sp.

[1] In the Zweif. Kais. Mus. Wien, V, p. 320, these authors give *affinis* as a probable variety of *polychæta,* but the two names are evidently referable to one and the same species. Schiner's statement in his Fauna Austriaca, Vol. I, p. 463, that in *affinis* the frontal bristles are in a single row, while in *polychæta* they are in two rows, or irregularly arranged, does not hold true in all the specimens; in one of those from Germany, referred to above, they are in a single row on one side of the front, but are irregularly arranged on the opposite side.

10. Third vein bearing three bristles near its base, apical cell narrowly open or closed and short petiolate; body with a brassy tinge; length, 5 to 6 mm. Colorado and Austria. A female specimen from Austria, received from Brauer and Bergenstamm and by them named *Aporomyia dubia* Rond. (Kongl. Svenska Vetensk. Akad. Hand., Vol. XXXI; 1810: *Tachina.*) . . . . *dubia* Fall.

Third vein bristly almost to the small crossvein, body with a bluish tinge; black, the palpi yellow; frontal bristles descending slightly below the arista, cheeks one-fourth as broad as the eye height, vibrissæ on a level with front edge of oral margin, two or three bristles above each, antennæ almost as long as the face, arista thickened on the basal half, thorax gray pollinose, marked with four black vittæ, scutellum bearing three long marginal pairs and a short apical pair of macrochætæ, abdomen on last three segments thinly bluish-gray pollinose, first segment bearing marginal, the other three with discal and marginal macrochætæ, bristly hairs of abdomen depressed; front tarsi greatly dilated, hind tibiæ outwardly bearing a few bristles of unequal length; wings hyaline, hind crossvein nearly straight, fourth vein strongly curved inward beyond the bend; calypteres white; length, 6 mm. Tifton, Ga. A single female specimen collected October 20, 1896, by Mr. G. R. Pilate. Type No. 3590, U. S. National Museum . . . . . *spinipennis* n. sp.

11. Middle tibiæ each bearing two or more macrochætæ on the front side near the middle . . . . . 13.

Middle tibiæ each bearing a single macrochæta on the front side near the middle, hind tibiæ outwardly ciliate . . . . . 12.

12. Apical pair of scutellar macrochætæ curving forward, scutellum wholly black, front in the male two-fifths, in the female from two-thirds to three-fourths, as wide as either eye, third joint of antennæ in both sexes three and one-half times as long as the second; black, the second joint of antennæ usually, the palpi, apex of proboscis, femora usually, and generally the tibiæ, yellow; face white, sides of front grayish white pollinose, two pairs of orbital bristles in the female, wanting in the male, frontal bristles descending to apex of second antennal joint, antennæ six sevenths as long as the face, arista thickened on the basal fourth, the penultimate joint shorter than broad; thorax gray pollinose, marked with four black vittæ, scutellum bearing three pairs of long marginal and a short forwardly directed apical pair of macrochætæ, abdomen wholly gray pollinose, with darker reflecting spots, the hairs depressed; wings hyaline, third vein bearing two or three bristles near its base, calypteres white, front pulvilli of male slightly longer than the last tarsal joint; length, 6 to 9 mm. Cotuit and Boston, Mass.; District of Columbia; and Camden, Ark. Four males and three females. Type No. 3591, U. S. National Museum . . *boarmia* n. sp.

Apical pair, etc.; differs from *boarmiæ* as follows: Front of male slightly wider than either eye, his third antennal joint six times as long as the second, antennæ and legs black, arista thickened on the basal two-fifths, abdomen subshining, bases of last three segments grayish pollinose, the hairs suberect and rather long, wings strongly tinged with gray at base and along the costa; length, 7 mm. Mt. Washington, N. H. A single male specimen collected by Mrs. A. T. Slosson ..... *fronto* n. sp.

Apical pair of scutellar macrochætæ directed backward; scutellum on the apex broadly yellow, front of female four-fifths as wide as either eye, third joint of antennæ four and one-half times as long as the second, femora black, third vein bearing four or five bristles at its base; length, 10 mm., otherwise as in the above description of *boarmiæ*. Franconia, N. H. Two female specimens collected by Mrs. A. T. Slosson. Type No. 3592, U. S. National Museum ..... *blandita* n. sp.

13. Scutellum black, pollen of thorax gray, hind tibiæ not ciliate, front in the female one-half as wide as either eye, her third antennal joint three times as long as the second; black, the second antennal joint, palpi and apex of proboscis, yellow; sides of front destitute of hairs, in the female bearing two pairs of orbital bristles, frontal bristles descending to middle of second antennal joint; thorax gray pollinose, marked with four black vittæ, scutellum bearing three pairs of long marginal macrochætæ, abdomen whitish pollinose, its hairs depressed, apex of fourth segment bare, this segment bearing a discal and marginal row of macrochætæ; wings hyaline, third vein bearing three bristles at its base, calypteres white; length, 7 mm. Dist. Columbia. A single female specimen. Type No. 3593, U. S. National Museum ... *isæ* n. sp.

Scutellum yellowish, pollen of thorax yellow, hind tibiæ outwardly ciliate, front of male two-thirds as wide as either eye, his third antennal joint four and one-half times as long as the second; black, the palpi, tibiæ largely, and scutellum yellow; sides of front bearing numerous bristly hairs, no orbital bristles in the male, frontal bristles descending to apex of second antennal joint, thorax yellowish pollinose, marked with four black vittæ, scutellum bearing four pairs of long marginal macrochætæ; abdomen wholly gray pollinose, its hairs rather long and suberect; wings hyaline, third vein bearing three bristles near its base, front calypteres white, the hind ones yellowish; front pulvilli of male slightly longer than the last tarsal joint; length, 10 mm. White Mountains, N. H. A single male specimen. Type No. 3594, U. S. National Museum ..... *helvina* n. sp.

11. With four sternopleural macrochætæ, hind tibiæ outwardly ciliate, middle tibiæ each bearing two or more macrochætæ on the front side near the middle, scutellum largely yellow, four postsutural macrochætæ, arista thickened to the middle ..... 15.

With three sternopleural macrochætæ ..... 18.
With only two sternopleural macrochætæ, hind tibiæ outwardly ciliate, arista thickened on the basal third ..... 16.

15. Palpi black, front in the male three-fourths, in the female one and one-sixth times, as wide as either eye; third joint of antennæ in the male five, in the female three, times as long as the second; length, 5 to 7 mm. White Mountains and Franconia, N. H.; Beverly, Mass.; District of Columbia; Shreveport, La.; Las Cruces, N. Mex.; Tucson, Ariz.; California, and Austria. Two males and one female from Austria, received from Brauer and Bergenstamm, and by them named *Parexorista confinis* Fall. (Diptera Suecicæ, Muscidæ, p. 32; 1820: *Tachina*. The following synonymy is given by Rondani and repeated by Schiner: *Phryxe zonata* Desvoidy, Essai sur les Myodaires, p. 159; 1830. The following is by Schiner: *Phryxe servillii* Desvoidy, l. c., and *Phryxe sabulosa* Desvoidy, l. c. The following is by the writer: *Tachina theclarum* Scudder, Canadian Entomologist, Vol. XIX, p. 166; September, 1887. *Exorista chrysophani* Townsend,[1] Entomological News, Vol. II, p. 197; December, 1891.) ... *confinis* Fall.

Palpi yellow, front in the male two-thirds, in the female three-fourths, the width of either eye; third joint of antennæ in each sex four times as long as the second; black, the palpi and scutellum, except at base, yellow; sides of front bearing scattered, rather short, hairs; two pairs of orbital bristles in the female, none in the male; antennæ nearly as long as the face, arista thickened almost to the middle, cheeks one-sixth as wide as the eye height, facial ridges bristly on the lowest fourth to half; thorax gray pollinose, marked with four black vittæ, scutellum bearing two long and two short pairs of marginal macrochætæ, abdomen on the last three segments gray pollinose except the apex of each, the hairs depressed; wings hyaline, base of third vein bearing two bristles, calypteres white; front pulvilli of male slightly longer than the last tarsal joint; length, 5.5 to 8 mm. Maryland, District of Columbia, and Virginia. Two males and five females. Type No. 3595, U. S. National Museum ..... *lobeliæ* n. sp.

16. With four postsutural macrochætæ ..... 17.
With only three postsutural macrochætæ, middle tibiæ each bearing a single macrochæta on the front side near the middle; black, the palpi, scutellum, femora, and tibiæ yellow; front in female two-thirds the width of either eye, the sides bearing numerous rather short hairs, two pairs of orbital bristles in the female, frontal bristles descending nearly to apex of second joint of antennæ, cheeks scarcely one-tenth as broad as the

[1] Mr. Townsend has admitted the synonymy of *chrysophani* and *theclarum* in Trans. Amer. Ent. Soc., Vol. XXII, p. 75; 1895.

eye height, antennæ nearly as long as the face, the third joint four times as long as the second, arista thickened on the basal third, the penultimate joint shorter than broad, facial ridges bristly on the basal fifth, thorax gray pollinose, marked with four black vittæ, scutellum bearing four pairs of long marginal macrochætæ, abdomen on the last three segments gray pollinose, the hairs rather long and suberect; wings hyaline, third vein bearing one or two bristles at its base, calypteres white; length, 9 mm. White Mountains, New Hampshire, and Frankford, Pa. Two females, collected by Mrs. A. T. Slosson and Mr. C. W. Johnson, August 20, 1895. Type No. 3596, U. S. National Museum ..... *amplexa* n. sp.

17. Palpi and legs black, middle tibiæ each bearing two or more macrochætæ on the front side near the middle; front in the male three-fourths, in the female one and one-sixth times, as wide as either eye; a dark brown reflecting spot below each of the lowest frontal bristles; third joint of antennæ in the male three and one-half, in the female two and one-fourth, times as long as the second; length, 9 to 11 mm. Sharon, Mass.; northern Illinois, California, and Oregon. (Can. Entomologist, Vol. XIX, p. 161; September, 1887: *Tachina* [*Exorista*]. *Parexorista futilis* O. S., Brauer and Bergenstamm *in litt.*) .... *futilis* O. S.

Palpi yellow, middle tibiæ each bearing a single macrochæta on the front side near the middle, front in female three-fifths as wide as either eye, her third antennal joint three and one-half times as long as the second, no dark spots below the lowest frontal bristles; length, 9 mm. Dist. Columbia. (Biologia Cent.-Amer., Diptera, Vol. II, p. 74; February, 1890.) .. *griseomicans* v. d. W.

18. Hind tibiæ outwardly ciliate ..... 19.

Hind tibiæ not ciliate, four postsutural macrochætæ, middle tibiæ each bearing two or more macrochætæ on the front side near the middle; black, the palpi yellow; front in male two-thirds as wide as either eye, the sides bearing numerous rather short hairs, no orbital bristles in the male, frontal bristles descending almost to apex of second antennal joint, cheeks one-sixth as wide as the eye height, facial ridges bristly on the lower half, antennæ nearly as long as the face, the third joint four times as long as the second, arista thickened nearly to the middle, the penultimate joint slightly longer than broad; thorax gray pollinose, marked with four black vittæ, scutellum bearing four pairs of marginal macrochætæ; abdomen whitish pollinose on bases of last three segments, its hairs subdepressed; wings hyaline, third vein bearing three bristles near its base, bend of fourth appendiculate, apical cell short petiolate, calypteres white; length, 6 mm. Virginia. A male specimen. Type No. 3597, U. S. National Museum .. *petiolata* n. sp.

19. Palpi yellow on at least the apical two-thirds ..... 22.
Palpi, except the tips, black ..... 20.

20. Middle tibiæ each bearing two or more macrochætæ on the front side near the middle ..... 21.
Middle tibiæ each bearing a single macrochæta on the front side near the middle; black; front of male three-fifths as wide as either eye, frontal bristles descending to the arista, no orbital bristles, hairs of front numerous and rather long, cheeks one-eighth as wide as the eye height, vibrissæ on a level with front edge of the oral margin, ridges bristly on the lowest fourth, antennæ almost as long as the face, the third joint six times as long as the second, arista thickened on the basal fourth, thorax whitish pollinose, marked with four black vittæ, scutellum bearing three marginal pairs and a short, cruciate apical pair of macrochætæ, the latter curving backward and nearly horizontal; abdomen shining, with a brassy tinge, narrow bases of the second and third segments whitish pollinose, each segment bearing marginal macrochætæ, the bristly hairs rather long and suberect; front pulvilli slightly longer than the last tarsal joint; wings hyaline, third vein bearing two or three bristles near the base; calypteres white; length, 7 mm. Tifton, Ga. A male specimen collected October 17, 1896, by Mr. G. R. Pilate. Type No. 3598, U. S. National Museum ..... *polita* n. sp.

21. With four postsutural macrochætæ (see under 17) ..... *futilis* O. S.
With only three postsutural macrochætæ, front in male four-fifths as wide as either eye, his third antennal joint three and one-half times as long as the second, several macrochætæ outside of the frontal bristles; length, 10 mm. Texas. (Biologia Cent.-Amer., Vol. II, p. 70; February, 1890.) ..... *angustata* v. d. W.

22. Thorax bearing four postsutural macrochætæ, abdomen not tinged with bronze, apical cell open ..... 24.
Thorax bearing only three postsutural macrochætæ, scutellum black, middle tibiæ each bearing a single macrochæta on the front side near the middle ..... 23.

23. Apical cell closed and short petiolate, abdomen strongly tinged with bronze; black, the palpi yellow; front of female one and one-sixth times as wide as either eye, the sides bearing numerous short hairs, two pairs of orbital bristles in the female, frontal bristles descending almost to apex of second antennal joint, cheeks nearly one-fourth as wide as the eye height, facial ridges bristly on the lower half; antennæ five-sixths as long as the face, the third joint three times as long as the second, arista thickened on the basal third, the penultimate joint slightly longer than wide; thorax gray pollinose, marked with four black vittæ, scutellum bearing three long marginal and a short apical pair of macrochætæ, abdomen gray pollinose on the bases of the last three segments, its hairs closely appressed,

the fourth segment bearing a discal and a marginal row of ma crochætæ; wings hyaline, third vein bearing three bristles near its base, bend of fourth vein not appendiculate, this vein nearly straight after the bend; calypteres white; length, 7 mm. Northern Ill. A female specimen collected by W. A. Nason. Type No. 3599, U. S. National Museum... *ærata* n. sp.

Apical cell open, abdomen not tinged with bronze: black, the palpi and inner side of each antenna largely yellow, sides of front bearing only a few short hairs, cheeks one-seventh as broad as the eye height, facial ridges bristly on the lowest fifth, third joint of antennæ slightly over twice as long as the second, thorax marked with three black vittæ, scutellum bearing two long and an intermediate short pair of marginal macrochætæ, abdomen on the last three segments gray pollinose and with numerous reflecting black spots, third vein of wing bearing a single bristle near its base, fourth vein strongly curved inward beyond the bend; length, 4 mm., otherwise as above description of *ærata*. Colorado. A female specimen collected by Carl F. Baker. Type No. 3600, U. S. National Museum..*parva* n. sp.

24. Middle tibiæ each bearing a single macrochæta on the front side near the middle, third joint of antennæ in each sex four times as long as the second..... 25.

Middle tibiæ each bearing two or more macrochætæ on the front side near the middle, scutellum largely yellow, pollen of body gray, front in male three-fifths, in the female two-thirds, as wide as either eye, third joint of antennæ in the male three and one-half, in the female three, times as long as the second; length, 6 to 11 mm. Canada; White Mountains, New Hampshire; New Bedford, Mass.; Clementon, N. J.; Maryland; District of Columbia; Virginia; Dayton, Ohio, and St. Louis, Mo. (Trans. Amer. Ent. Soc., Vol. XIX, p. 287; December, 1892. *Myxexorista* sp., Brauer and Bergenstamm *in litt.* *Sisyropa* sp., Brauer and Bergenstamm *in litt.*).....*eudryæ* Town.

25. Scutellum largely yellow; hairs on basal half of fourth segment of abdomen two-thirds as long as the macrochætæ, front in the male three-fifths, in the female two-thirds, as wide as either eye, the sides olive gray pollinose and bearing numerous nearly erect short hairs; length, 6 to 9 mm. District of Columbia; Jennings, Va.; Fort George, Fla.; and Miss. (Biol. Cent.-Amer., Diptera, Vol. II, p. 69; February, 1890. *Myxexorista* sp., Brauer and Bergenstamm *in litt.*).....*flavirostris* v. d. W.

Scutellum black; hairs on basal half of fourth segment of abdomen one-third as long as the macrochætæ, front in the male two-thirds, in the female one and one-sixth times, as wide as either eye, the sides silvery gray pollinose, bearing a few very short inconspicuous hairs; black, the second antennal joint, apex of proboscis, and the palpi yellow; two pairs of orbital

bristles in the female, none in the male; frontal bristles descending slightly below the arista, cheeks one-sixth as broad as the eye-height, facial ridges bristly on the lowest third, antennæ almost as long as the face, arista thickened on the basal third or fourth, the penultimate joint as broad as long; thorax gray pollinose, marked with four black vittæ, scutellum bearing four marginal pairs of macrochætæ; abdomen on last three segments wholly gray pollinose, the hairs depressed; wings hyaline, base of third vein bearing two bristles, bend of fourth vein not appendiculate, this vein beyond the bend strongly bent inward; calypteres white, front pulvilli of male longer than the last tarsal joint; length, 5.5 to 8 mm. St. Louis, Mo.; Oswego, Kans.; and Fort Worth, Tex. Four males and two females. Type No. 3601, U. S. National Museum..... *ceratomiæ* n. sp.

Genus EUPHOROCERA Town.

Euphorocera Townsend, Trans. Amer. Ent. Soc., Vol. XIX, p. 112; May, 1892.

Our species have two or more macrochætæ on the front side of each middle tibia near the middle, and the hind tibiæ outwardly are ciliate or subciliate:

1. Head at the vibrissæ noticeably shorter than at base of antennæ, palpi yellow, three sternopleural macrochætæ..... 2.

   Head at the vibrissæ as long as at base of antennæ, palpi black; black, apex of scutellum broadly yellow; front in the male four-fifths, in the female one and one-fifth times, as wide as either eye, two pairs of orbital bristles in the female, wanting in the male, sides of front gray pollinose, destitute of macrochætæ outside of the frontal bristles, the latter descending below the arista, cheeks one-third as broad as the eye-height, facial ridges bristly on the lower two thirds, antennæ six-sevenths as long as the face, the third joint in the male three, in the female two and one-fourth, times as long as the second, arista thickened almost to the middle, the penultimate joint slightly longer than broad; thorax gray pollinose, marked with four black vittæ, four post-sutural and two large and sometimes two small sternopleural macrochætæ, scutellum bearing four marginal pairs; abdomen shining, bases of the last three segments gray pollinose, hairs rather long and suberect, first segment bearing marginal, the next two with discal and marginal, the fourth covered with macrochætæ except its extreme base; front pulvilli of male longer than the last tarsal joint; wings hyaline, third vein bearing from four to eight bristles at the base, fourth vein beyond the bend strongly arcuate, apical cell narrowly open; calypteres white; length, 7 to 9 mm. Point Barrows, Alaska. One male and two females collected June 24, 1882, by Mr. John Murdock. Type No. 3602, U. S. National Museum..... *gelida* n. sp.

2. With only three postsutural macrochætæ, second and third segments of abdomen bearing discal macrochætæ, facial ridges hairy outside of the bristles, front of female slightly wider than either eye, the sides and face whitish pollinose, third joint of antennæ two and one-half times as long as the second, arista thickened on the basal third, the penultimate joint slightly longer than wide; abdomen subshining, gray pollinose, marked with dark reflecting spots; length, 9 mm. Franconia, N. H. (Biol. Cent.-Amer., Diptera, Vol. II, p. 81; Feb., 1890: *Phorocera.*) ..... *cinerea* v. d. W.

With four postsutural macrochætæ, second and third segments of abdomen destitute of discal macrochætæ, facial ridges bare outside of the bristles; length, 5 to 14 mm. Franconia, N. H.; Massachusetts; Brooklyn, N. Y.; District of Columbia; Virginia; Indiana; Illinois; Jackson, Tenn.; Tifton, Ga.; Crescent City, Fla.; Mississippi; St. Louis, Mo.; Louisiana; Texas; Colorado; Las Cruces, N. Mex., and California. (Dipteres Exotiques, Supplement III, p. 209 [49]; 1847: *Phorocera. Erygaster septentrionalis* Walker, Lord's Naturalist in Vancouver Island, Vol. II, p. 339; 1866. *Phorocera edwardsii* Williston, Scudder's Butterflies of New England, Vol. III, p. 1921; 1889. *Podotachina vibrissata* Brauer and Bergenstamm, Zweif. Kais. Mus. Wien, V, p. 351; 1891: also *in litt. Euphorocera tachinomoides* Townsend, Trans. Amer. Ent. Soc., Vol. XIX, p. 112; May, 1892. *Phorocera lophyri* Townsend, loc. cit., p. 289; December, 1892.) ..... *claripennis* Macq.

Genus PHOROCERA Desv.

Phorocera Desvoidy, Essai sur les Myodaires, p. 131; 1830.
Blondelia Desvoidy, loc. cit., p. 122.
Rhinomya Desvoidy, loc. cit., p. 123.
Pales Desvoidy, loc. cit., p. 154.

This synonymy is given by Macquart[1] and repeated by Schiner;[2] Brauer and Bergenstamm also give Pales as equivalent to Phorocera,[3] but make no mention of the other two names:

1. With four sternopleural and four postsutural macrochætæ, palpi black, second and third segments of abdomen bearing discal macrochætæ, sides of front destitute of macrochætæ outside of the frontal bristles, except the orbital bristles of the female; front in the male two-thirds as wide as, in the female slightly wider than, either eye; frontal bristles descending below the arista, the latter thickened on its basal third; third joint of antennæ in the male six, in the female four, times as long as the

[1] Annales Soc. Ent. France, p. 420; 1850.
[2] Fauna Austrica, Vol. I, p. 488; 1862.
[3] Zweif. Kais. Mus. Wien, VI, p. 234; 1893.

second; sides of face below the lowest frontal bristles bare, middle tibiæ each bearing a single macrochæta on the front side near the middle; length, 6 mm. Camden, Ark., and Los Angeles County, Cal. (Annales Soc. Ent. France, Vol. VIII, p. 260; 1888.) ..... *parva* Bigot.

With three sternopleural macrochætæ ..... 2.

With only two sternopleural and four postsutural macrochætæ; middle tibiæ each bearing two or more macrochætæ on the front side near the middle, hind tibiæ outwardly ciliate; black, the palpi brown, the scutellum yellow except at the base, sides of first three segments of abdomen sometimes partly yellow; front in the male three-fifths as broad as either eye, frontal bristles descending to tip of second antennal joint, cheeks scarcely one-eighth as broad as the eye-height, antennæ almost as long as the face, the third joint four and one-half times as long as the second, arista thickened on the basal third, facial ridges bristly on the lower three-fifths to three-fourths; thorax lightly gray pollinose, marked with three broad black vittæ, scutellum bearing four pairs of long marginal macrochætæ, the last pair cruciate and inclined downward; abdomen subshining, the last three segments lightly whitish pollinose, the extreme apices of the segments bare, the bristly hairs rather long and almost erect, first two segments each bearing a marginal pair of macrochætæ, the third with a marginal row, the fourth wholly covered except the extreme base; front pulvilli slightly longer than the last tarsal joint; wings hyaline, the base to apex of second basal cell gray, third vein bearing two bristles at its base; calypteres whitish; length, 6 to 9 mm. Michigan and Missouri. Three male specimens. Type No. 3603, U. S. National Museum ... *tortricis* n. sp.

2. Thorax bearing three postsutural macrochætæ ..... 3.

Thorax bearing four postsuturals, hind tibiæ outwardly ciliate, second and third segments of abdomen bearing discal macrochætæ, several macrochætæ outside of the frontal bristles ... 6.

3. Hind tibiæ outwardly ciliate, scutellum bearing four marginal pairs of macrochætæ ..... 5.

Hind tibiæ not ciliate, scutellum bearing only three pairs of marginal macrochætæ, body slender, last three segments of abdomen destitute of pollen on the broad apices, pollen of face white .. 4.

4. Second and third segments of abdomen destitute of discal macrochætæ, middle tibiæ each bearing only one macrochæta on the front side near the middle; length, 7 mm. Utica, Miss. (Biol. Cent.-Amer., Diptera, Vol. II, p. 84; Feb., 1890.) *macra* v. d. W.

Second and third segments of abdomen bearing discal macrochætæ, middle tibiæ each bearing two on the front side near the middle; length, 9 mm. Newark, N. J. (Biol. Cent.-Amer., Diptera, Vol. II, p. 79; February, 1890.) ..... *rufilabris* v. d. W.

5. Abdomen wholly covered with pollen, opaque; face yellowish pollinose, third antennal joint four times as long as the second; black, the palpi usually and apex of proboscis, yellow, a spot on sides of abdomen of male and the tibiæ also sometimes yellow; front of the male three-fifths, of the female three-fourths, as broad as either eye, two pairs of orbital bristles in the female, none in the male, frontal bristles descending below the arista, cheeks one-fourth as broad as the eye height, antennæ nearly as long as the face, arista thickened on the basal third, facial ridges bristly on the lower four-fifths; thorax gray pollinose, marked with four black vittæ; bristly hairs of abdomen depressed, first two segments each bearing a marginal pair, the third with a marginal row, the fourth with a discal and a marginal row of macrochætæ; wings hyaline, base of third vein bearing two bristles, fourth vein strongly arcuate beyond the bend; calypteres white; length, 7 to 11 mm. Dist. Columbia; Lexington, Ky., and Tenn. Three males and two females. Type No. 3604, U. S. National Museum ..... *leucaniæ* n. sp.

Abdomen destitute of pollen on the broad apices of the last three segments, face white pollinose, third antennal joint from two and one-half to three times as long as the second, front of female from five-sixths as wide as to slightly wider than either eye, frontal bristles descending almost to apex of second antennal joint, facial ridges bristly on the basal two-thirds, third vein bearing two or three bristles at the base, second and third segments of abdomen sometimes bearing discal macrochætæ; length, 6 to 8 mm.; otherwise as in the above description of *leucaniæ*. Northern Illinois, Missouri, Colorado, and Mesilla, N. Mex. (First Rept. Insects of Missouri, p. 111; March, 1869: *Lydella*.) ..... *doryphoræ* Riley.

6. Middle tibiæ each bearing two or more macrochætæ on the front side near the middle ..... 7.

Middle tibiæ each bearing a single macrochæta on the front side near the middle, sides of face below the lowest frontal bristles bare, arista thickened to the middle, the penultimate joint only slightly longer than broad, front in each sex one and one-fourth times as wide as either eye, frontal bristles descending below the arista, third joint of antennæ in the male six, in the female four, times as long as the second; palpi yellow; length, 8 to 9 mm. Dist. Columbia, Bluffton, S. C., and Missouri. (In Scudder's Butt. New England, Vol. III, p. 1922; 1889) ..... *comstocki* Will.

7. Sides of face below the lowest frontal bristles bare, arista thickened on the basal three fourths, the penultimate joint three times as long as wide, front in each sex one and one-fourth times as broad as either eye, frontal bristles descending below the arista,

third joint of antennæ in the male six, in the female four, times as long as the second, apical cell closed; length, 8 to 9 mm. Alameda County, Cal. (In Scudder's Butterflies of New England, Vol. III, p. 1922; 1889.) ..... *saundersii* Will.

Sides of face below the frontal bristles bristly two-fifths of the distance to the vibrissæ, arista thickened on the basal third, the penultimate joint only slightly longer than wide; black, the palpi, apex of scutellum, front corners of the second segment of the abdomen, tibiæ, and sometimes base of antennæ, yellowish; front in male scarcely wider than, in the female one and one-fourth times as wide as, either eye, two pairs of orbital bristles in the female, none in the male, frontal bristles descending to the arista, cheeks nearly one-half as wide as the eye-height, antennæ about as long as the face, the third joint six times as long as the second; thorax gray pollinose, marked with four black vittæ, scutellum bearing four pairs of marginal macrochætæ; abdomen wholly gray pollinose and with reflecting darker spots; wings hyaline, base of third vein bearing three bristles, fourth vein beyond the bend distinctly arcuate, calypteres white; length, 7 to 10 mm. San Diego, Tex. A specimen of each sex collected April 30, 1895, by Mr. E. A. Schwarz. Type No. 3606, U. S. National Museum ..... *facialis* n. sp.

Unrecognized species.—*P.*? (*Tachina*) *antennata* Walker; U. S. *P.*? (*Tachina*) *melobosis* Walker. (Syn. *Tachina addita* Walker.)

Genus FRONTINA Meig.

Frontina Meigen, Systematische Besch. Eur. Zweif. Insekten, Vol. VII, p. 247; 1838.
Prosopea Rondani, Dipterologiæ Italicæ Prodromus, Vol. IV, p. 36; 1861.
Achætoneura Brauer and Bergenstamm, Zweif. Kais. Mus. Wien, V, p. 334; 1891.
Thysanomyia Brauer and Bergenstamm, loc. cit., p. 340.
Parafrontina Brauer and Bergenstamm, loc. cit., VI, p. 115; 1893.

Brauer and Bergenstamm place Prosopea, Achætoneura, and Parafrontina as subgenera of Frontina;[1] and although they place Thysanomyia in a different section, it can not be generically separated from Frontina.[2] Four Austrian specimens of *Frontina laeta* Meig., the type species of this genus, received from and identified by Brauer and Bergenstamm, have the hind tibiæ outwardly ciliate, as in our species. The latter have the palpi yellow, and from two to four bristles on the base of the third vein:

1. With four sternopleural macrochætæ, scutellum largely yellow and bearing three or four pairs of long marginal and a short apical

[1] Zweif. Kais. Mus. Wien, VI, p. 212; 1893.

[2] Of two specimens of *Frontina aletiæ* sent by Dr. Riley to Brauer and Bergenstamm, one was referred by them to Prosopea and the other to Thysanomyia; of three specimens of *Frontina archippivora*, one was by them referred to Parafrontina and two to Achætoneura, and of fifteen specimens of *Frontina frenchii*, they referred one to Hemimasicera, two to Prosopea, and twelve to Achætoneura.

pair of macrochætæ, second and third segments of abdomen destitute of discal macrochætæ, venter destitute of short black spines ..... 4.

With only three sternopleural macrochætæ, scutellum black, front pulvilli of male slightly longer than the last tarsal joint.... 2.

2. Third joint of antennæ of male five, in the female four, times as long as the second, front of male three-fourths, in the female one and one-fifth times, as wide as either eye; abdomen black, narrow bases of last three segments gray pollinose, second and third segments destitute of discal macrochætæ, middle tibiæ each bearing a single one on the front side near the middle; length, 5 mm. Eastboro, Conn., and Tifton, Ga. (Insecta Saundersiana, Vol. I, p. 299; 1856: *Tachina*.) ..... *ancilla* Walk.

Third joint of antennæ in both sexes two and one-half times as long as the second, front in the male one-half, in the female three-fourths, as broad as either eye, three postsutural macrochætæ, scutellum bearing three pairs of long marginal ones, destitute of a short apical pair, second and third segments of abdomen in the male bearing discal macrochætæ, wanting in the female, venter of these segments in the female thickly studded with short black spines ..... 3.

3. Abdomen in both sexes yellowish except a dorsal vitta, a fascia on the third segment, which sometimes covers it, and the base of the fourth, which are black; length, 6 to 9 mm. Tifton, Ga., and Jacksonville and Lake Worth, Fla. (Proc. Acad. Nat. Sci. Phila., p. 310; September, 1895: *Achætoneura*.) ... *rubentis* Coq.

Abdomen of male black, a spot on each side of first three segments and the narrow apex of the fourth, yellow; in the female black, the narrow apex of the fourth segment yellow; length, 7 to 8.5 mm. Southern California and Allende, Mexico. From the type specimen. (Insect Life, Vol. I, p. 332; May, 1889: *Tachina* [*Masicera*]. *Prospherysa comosa* van der Wulp, Biologia Cent.-Amer., Diptera, Vol. II, p. 119; May, 1890.) .. *armigera* Coq.

4. Second segment of abdomen destitute of a marginal pair of macrochætæ or else the sides of the third segment largely or wholly yellow ..... 6.

Second segment bearing a marginal pair of stout macrochætæ, abdomen black, at most with a yellow spot on each side of the second segment, third joint of antennæ of male from five and one-half to seven, in the female from three to four and one-half, times as long as the second ..... 5.

5. Front in the male one and one-half, in the female one and three-fourths, times as wide as either eye, front pulvilli of male three-fourths as long as the last tarsal joint; length, 6 to 9 mm. Michigan; Missouri; Texas; California, and Pullman, Wash. (In Scudder's Butterflies of New England, Vol. III, p. 1923;

1889: *Masicera*. *Achætoneura* sp., and *Parafrontina* sp., Brauer and Bergenstamm *in litt.*) ..... *archippivora*[1] Will.—

Front in the male at most slightly wider than, in the female one and one-third times as wide as, either eye, front pulvilli of male slightly longer than the last tarsal joint; length, 5 to 11 mm. Canada; Beverly, Mass.; New Jersey; Pennsylvania; Lakeland, Md.; District of Columbia; Virginia; Brookville, Ind.; Carbondale, Ill.; Missouri, and California. (In Scudder's Butterflies of New England, Vol. III, p. 1923; 1889: *Masicera. Achætoneura hesperus* Brauer and Bergenstamm, Zweif. Kais. Mus. Wien, V, p. 334; 1891. *Phorocera promiscua*[2] Townsend, Psyche, Vol. VI, p. 84; May, 1891. *Meigenia websteri* Townsend, Canadian Entomologist, Vol. XXIII, p. 203; October, 1891. *Masicera schizuræ*[2] Townsend, Psyche, Vol. VI, p. 187; December, 1891: from a co-type specimen received from Mr. Townsend. *Masicera datanarum* Townsend, Trans. Amer. Ent. Soc., Vol. XIX, p. 287; December, 1892. *Tachina anonyma* Riley MS.: from the proposed type specimen. *Achætoneura* sp., Brauer and Bergenstamm *in litt.* *Prosopæa* sp., Brauer and Bergenstamm *in litt.* *Hemimasicera* sp., Brauer and Bergenstamm *in litt.*) ..... *frenchii* Will.—

6. Abdomen in both sexes yellow on sides of the third segment, second segment in the male bearing a marginal pair of macrochætæ, or else his front pulvilli only three-fourths as long as the last tarsal joint ..... 7.

Abdomen of the female black, at most with a yellow spot each side of the second segment, this segment in both sexes destitute of a marginal pair of macrochætæ, front pulvilli of male slightly longer than the last tarsal joint, third joint of antennæ of male from two and three-fourths to five, in the female from two and three-fourths to three and one-third, times as long as the second; length, 6 to 11 mm. Toronto, Canada; Beverly, Mass.; Brooklyn, N. Y.; District of Columbia; Georgia; Charlotte Harbor, Florida; Mississippi; Brazoria, Tex.; Los Angeles, Cal., and Venezuela, South America. (Canadian Entomologist, Vol. XI, p. 162; 1879: *Tachina:* from a co type specimen. *Tachina fraterna* Comstock, Report Commissioner Agric. for 1879, p. 303; 1880. *Prosopæa* sp. Brauer and Bergenstamm *in litt.* *Thysanomyia* sp. Brauer and Bergenstamm *in litt.*) ..... *aletiæ* Riley. —

[1] This species is usually credited to Riley, but he never described it so far as I am aware.

[2] In Psyche for June, 1893, page 467, Mr. Townsend reports having received from Professor Forbes two Tachina flies bred "from pupæ of *Euchætes egle*. Breeding cage, May 4, 1880." One of these he refers to *Masicera schizuræ* and the other to *Prospherysa promiscua*, apparently without suspecting that both of them belonged to one and the same species.

7. Front pulvilli of male distinctly longer than the last tarsal joint, fourth segment of abdomen in both sexes black except the front corners, third joint of antennæ in the male four, in the female from two and three-fourths to three and one-third, times as long as the second; length, 7 to 8 mm. District of Columbia. (List of Dipterous Insects, Part IV, p. 788; 1849: *Tachina. Masicera dubia* Williston, in Scudder's Butterflies of New England, Vol. III, p. 1924; 1889. *Masicera sphingivora* Townsend, Trans. Amer. Ent. Soc., Vol. XIX, p. 286; Dec., 1892.) . . *violenta* Walk.

Front pulvilli of male only three-fourths as long as the last tarsal joint, fourth segment of abdomen in both sexes yellow except a narrow black dorsal vitta, third joint of antennæ in both sexes two and one-half times as long as the second; length, 8 mm. Jacksonville, Fla. (List of Dipterous Insects, Part IV, p. 788; 1849: *Tachina. Masicera rileyi* Williston, in Scudder's Butterflies of New England, Vol. III, p. 1924; 1889.) . . *irrequieta* Walk.

Unrecognized species.—*F.?* (*Tachina*) *dydas* Walker; Brit. Amer.

Genus STURMIA Desv.

Sturmia Desvoidy, Essai sur les Myodaires, p. 171; 1830.
Blepharipa Rondani, Dipterologiæ Italicæ Prodromus, Vol. I, p. 71; 1856.
Ctenocnemis Kowarz, Verhand. Zool. Botan. Gesell. Wien, Vol. XXII, p. 460; 1873.
Blepharipoda Brauer and Bergenstamm, Zweif. Kais. Mus. Wien, IV, p. 96; 1889.
Argyrophylax Brauer and Bergenstamm, loc. cit., p. 163.

Blepharipa was proposed for the genus Sturmia of Desvoidy, owing to the fact that the latter name had been previously used in botany; but, according to present usage, botanical names do not interfere with those employed in zoology. Ctenocnemis and Blepharipoda were proposed to take the place of Blepharipa, owing to the faulty construction of the latter name. In the Zweif. Kais. Mus. Wien, VI, p. 213: 1893, Brauer and Bergenstamm reduce Argyrophylax to the rank of a subgenus of Blepharipoda.[1] All of our species have four postsutural macrochætæ:

1. With four sternopleural macrochætæ . . . . . 7.
With three sternopleural macrochætæ . . . . . 2.
With only two sternopleurals; black, the palpi, at least on the apical half, and apex of proboscis, yellow; front of female from two-thirds to three-fourths as wide as either eye, two pairs of orbital bristles, a stout backwardly curving macrochæta between them and the frontal bristles, the latter descending nearly to middle

[1] In Scudder's Nomenclator Zoologicus, Supplemental List (p. 46), 1882, is cited a *Blepharopoda* Rondani, Nuovi Annali Sci. Nat. Bologna, Ser. 3, Vol. II, p. 362; 1851, and on page 92 of the same work the genus *Ctenocnemis* of Kowarz is, on the authority of Mr. Verrall, made synonymous with *Blepharopoda*. The writer has been unable to consult the above-mentioned paper by Rondani, but if Mr. Verrall's reference is correct, the name of and reference to *Blepharopoda* Rond. should be inserted immediately after *Sturmia* in the above list of synonyms.

of second joint of antennæ, cheeks one-ninth as wide as the eye height, vibrissæ slightly below the level of front edge of oral margin, ridges bristly on the lowest third, antennæ almost as long as the face, the third joint five times as long as the second, arista thickened on the basal fourth, the penultimate joint shorter than broad; thorax gray pollinose, marked with four black vittæ, scutellum bearing three pairs of marginal macrochætæ and a short apical pair, abdomen opaque gray pollinose, each segment bearing marginal macrochætæ, middle tibiæ each having a single one on the front side near the middle; wings hyaline, third vein bearing from three to six bristles near its base, fourth vein beyond the bend strongly arcuate, calypteres whitish; length, 9 mm. Missouri. Two female specimens. Type No. 3609, U. S. National Museum..... *sternalis* n. sp.

2. Palpi yellow..... 3.

Palpi usually black, fourth segment of abdomen and apex of scutellum yellow; middle tibiæ each bearing a single macrochæta on the front side near the middle, third vein bearing two or three bristles near the base; black, apex of scutellum and of fourth segment of abdomen, also sometimes the palpi, yellow; front of male one half, of the female four-fifths, as wide as either eye; two pairs of orbital bristles in the female, none in the male; frontal bristles descending nearly to apex of second joint of antennæ, cheeks one-sixth as wide as the eye height, vibrissæ on a level with the front edge of oral margin, three bristles above each, antennæ almost as long as the face, the third joint in the male three and one-half, in the female two and one-half, times as long as the second, arista thickened on the basal two-fifths, the penultimate joint as broad as long; thorax gray pollinose, marked with four black vittæ, scutellum bearing four marginal pairs of macrochætæ; abdomen on the second and third segments gray pollinose and with darker reflecting spots, bearing only marginal macrochætæ; wings hyaline, fourth vein beyond the bend strongly arcuate, calypteres white; length, 6 mm. Cape Cod, Mass., and Piney Point, Md. A specimen of each sex; the male bred October 7, 1889, from a species of Phyciodes. Type No. 3610, U. S. National Museum.. *phyciodis* n. sp.

3. Middle tibiæ each bearing a single macrochæta on the front side near the middle..... 5.

Middle tibiæ each bearing three or more macrochætæ on the front side near the middle, apex of abdomen black..... 4.

4. Abdomen destitute of discal macrochætæ on the second and third segments, the fourth wholly covered except on the base, none of the macrochætæ on this segment more than three-fourths as long as those on the third; apex of scutellum broadly yellow, third vein bearing two bristles at its base; length, 9 to 11 mm.

Beverly, Mass.; Hartford, Conn.; Virginia; Columbia, S. C.; Savannah, Ga.; Centerville, Fla.; northern Illinois; Tennessee; Waco and Paris, Tex., and San Jose, Cal. (Insecta Saundersiana, Vol. I, p. 283; 1856: *Tachina. Tachina obconica* Walker, loc. cit., p. 296. *Hemimasicera* sp., Brauer and Bergenstamm *in litt.*) ..... *albifrons* Walk.

Abdomen bearing discal macrochætæ on the second and third segments; black, the first two joints of the antennæ, palpi, and apex of scutellum, yellow; front of female almost as wide as either eye, frontal bristles descending beneath the arista, sides of face yellowish-white pollinose, vibrissæ on a level with front edge of the oral margin, ridges bristly on the lowest two-fifths, cheeks one-fifth as broad as the eye height; third joint of antennæ two and one third times as long as the second, arista thickened on the basal half; thorax bluish-gray pollinose, marked with four black vittæ, four postsutural macrochætæ, scutellum bearing three long marginal pairs and a short apical one; abdomen subshining, thinly white pollinose; wings hyaline, tinged with yellowish at the base and along the costa, third vein bearing two or three bristles at the base, calypteres white; length, 9 mm. Seattle, Wash. One female. . . *occidentalis* n. sp.

Abdomen bearing discal macrochætæ, etc. Differs from *occidentalis* as follows: Coxæ, femora, and tibiæ, yellow; front of male one-half as wide as either eye, sides of face white pollinose, facial ridges bristly on the lowest fifth, third joint of antennæ four times as long as the second, arista thickened on the basal two-fifths, abdomen opaque gray pollinose, marked with olive-brown reflecting spots, wings not tinged with yellow; length, 9 mm. Florida. A single male specimen, collected by Mrs. A. T. Slosson ..... *australis* n. sp.

5. Second and third segments of abdomen destitute of discal macrochætæ, apex of abdomen and of scutellum yellow ..... 6.

Second, third, and fourth segments bearing discal macrochætæ, some on the fourth as long as those on the third, apex of abdomen and of scutellum black, third vein bearing three bristles at its base; length, 6.5 mm. Jacksonville, Fla. (Biol. Cent.-Am., Dipt., Vol. II, p. 105; March, 1890: *Masicera.*) ..... *strigata* v. d. W.

6. Cheeks one-sixth as broad as the eye height, frontal bristles not reaching to base of third joint of antennæ (see above under 3). *phyciodis* n. sp.

Cheeks one-ninth as broad as the eye height, frontal bristles descending below the arista, third vein bearing a single bristle near the base; black, the palpi, apex of scutellum, and sides and apex of abdomen, yellow; front of female three-fourths as wide as either eye, third joint of antennæ three and one-half times as long as the second, arista thickened on the basal fourth; otherwise as in the above description of *phyciodis*. A single female specimen

bred October 7, 1886, from *Harrisina americana*. Type No. 3611, U. S. National Museum ..... *harrisinæ* n. sp.

7. Middle tibiæ each bearing a single macrochæta on the front side near the middle, palpi, except sometimes the extreme apex, black ..... 8.

Middle tibiæ each bearing two or more macrochætæ on the front side near the middle, fourth segment of abdomen black ..... 10.

8. Third vein bearing a single bristle near its base ..... 9.

Third vein bearing two bristles near its base; black, including the palpi; front of female slightly narrower than either eye, frontal bristles descending to base of third antennal joint, hairs of front rather long and abundant, cheeks one-eighth as wide as the eye height, vibrissæ on a level with front edge of oral margin, ridges bristly on the lowest fifth, antennæ almost as long as the face, the third joint from twice to three and one fourth times as long as the second, arista thickened on the basal two-fifths, the penultimate joint as broad as long; thorax gray pollinose, marked with four black vittæ, scutellum bearing four marginal pairs of macrochætæ, that at the apex curving backward and nearly horizontal; abdomen shining, bases of last three segments whitish pollinose, second and third segments bearing marginal macrochætæ, the fourth covered except at base with much shorter ones than those on the third; wings hyaline, calypteres white; length, 5 mm. Tifton, Ga. Four female specimens collected October 1, 10, 15, and 17, by Mr. G. R. Pilate. Type No. 3612, U. S. National Museum ..... *pilatei* n. sp.

9. Fourth segment of abdomen wholly or largely yellow, its pollen golden yellow; length, 7 to 10 mm. Virginia; Tifton, Ga.; Mississippi; Palestine, Tex.; Carbondale, Ill.; Alameda County, Cal., and Kingston, Jamaica, West Indies. (Ausser. Zwei. Insekten, Vol. II, p. 334; 1830: *Tachina. Masicera protoparcis* Townsend, Journal Jamaica Institute, Vol. I, p. 70; 1892: from two cotype specimens.) ..... *distincta* Wied.

Fourth segment largely or wholly black, its pollen gray; length, 6 to 12 mm. District of Columbia; Carbondale, Ill.; Kirkwood, Mo.; Georgia; Mississippi; St. Louis, Mo.; Baton Rouge, La., and Colorado. (Biol. Cent.-Amer., Diptera, Vol. II, p. 107; March, 1890: *Masicera. Argyrophylax* sp., Brauer and Bergenstamm *in litt.*) ..... *inquinata* v. d. W.

10. Second and third segments of abdomen destitute of discal macrochætæ ..... 11.

Second and third segments bearing discal macrochætæ, apical pair on the scutellum almost vertical, scutellum and palpi black, third antennal joint nearly four times as long as the second, third vein bearing a single bristle at its base; length, 7 mm. Colorado. (Trans. Amer. Ent. Soc., Vol. XVIII, p. 358; November, 1891: *Masicera.*) ..... *nigrita* Town.

11. Palpi yellow, the three uppermost frontal bristles in each row noticeably longer than the next ones .... 12.

Palpi, except the apices, black, the three uppermost frontal bristles not longer than those below them, no hairs below the lowest ones, vibrissæ on a level with front edge of the oral margin; black, the apices of palpi and of scutellum, yellow; no orbital nor ocellar bristles in the male, frontal bristles descending to base of third antennal joint, cheeks one-fifth as broad as the eye height, facial ridges bristly on the lowest fourth, antennæ nearly as long as the face, the third joint twice as long as the second, penultimate joint of arista slightly longer than broad; thorax gray pollinose, marked with four black vittæ, abdomen gray pollinose on the last three segments, with reflecting darker spots, the narrow hind margins of the segments shining black, hairs depressed, first three segments bearing marginal macrochætæ, wings hyaline, slightly tinged with yellow basally, third vein bearing two bristles at its base, fourth vein beyond the bend nearly straight, calypteres whitish; front pulvilli slightly longer than the last tarsal joint; length, 9 mm. Colorado. A single male specimen collected by Mr. Carl F. Baker. Type No. 3613, U. S. National Museum.....*bakeri* n. sp.

12. Front in the male as broad as, in the female one and one fourth times as broad as, either eye, third joint of antennæ two and one-third times as long as the second, apical pair of macrochætæ on scutellum curving backward and nearly horizontal, vibrissæ noticeably above the level of front edge of the oral margin, arista thickened on the basal three-fifths; length, 11 mm. Horseneck Beach, Mass.; southern Illinois, and Florida. (Biol. Cent.-Amer., Diptera, Vol. II, p. 110; March, 1890: *Masicera.*) ....*fraudulenta* v. d. W.

Front in the male two-thirds, in the female four-fifths, as wide as either eye, third joint of antennæ four times as long as the second, arista thickened on the basal two-fifths, vibrissæ on a level with front edge of the oral margin, apical pair of macrochætæ on the scutellum curving forward and suberect; black, the palpi, and sometimes apex of scutellum and sides of the second abdominal segment, hind angles of the first and front angles of the third, yellow; frontal bristles descending slightly below the arista, sides of front bearing numerous bristly hairs and one or two macrochætæ, two pairs of orbital bristles in the female, none in the male, cheeks one-fifth as broad as the eye-height, facial ridges bristly on the lower half, the bristles ascending two-thirds or more of distance from the vibrissæ to the lowest frontal bristles, antennæ nearly as long as the face, penultimate joint of arista slightly longer than broad; thorax gray pollinose, marked with four black vittæ, abdomen on last

three segments gray pollinose, with reflecting black spots, second and third segments bearing marginal macrochætæ, the fourth wholly covered; front pulvilli of male longer than the last tarsal joint; wings hyaline, third vein bearing three or four bristles at the base, fourth vein beyond the bend arcuate, calypteres white; length, 10 mm. Pullman, Wash. Two males and three females bred by Prof. C. V. Piper from *Schizura ipomœæ*. Type No. 3614, U. S. National Museum..... *schizuræ* n. sp.

Genus MASICERA Macq.

Masicera Macquart, Histoire Naturelle Insectes, Dipteres, Vol. II, p. 118; 1835.
Ceromasia Rondani, Dipterologiæ Italicæ Prodromus, Vol. I, p. 71; 1856.
Dexodes Brauer and Bergenstamm, Zweif. Kais. Mus. Wien, IV, p. 87; 1889.
Hemimasicera Brauer and Bergenstamm, loc. cit.

The last-named authors place Dexodes and Hemimasicera as subgenera of Ceromasia, and retain Masicera as a distinct genus.[1] A comparison of species placed by these authors in both of these so-called genera shows that they are too closely related to be separated into different genera:

1. Thorax bearing four postsutural macrochætæ, two or more on front side of each middle tibia near the middle, apex of abdomen black ..... 2.

   Thorax bearing only three postsutural and three sternopleural macrochætæ, second and third abdominal segments bearing discal as well as marginal ones ..... 4.

2. Second and third segments of abdomen bearing discal macrochætæ, apical pair on scutellum nearly horizontal ..... 3.

   Second and third segments destitute of discal macrochætæ; black, the second antennal joint, palpi and usually the scutellum except the base, yellow; front of female one and one-fourth times as wide as either eye, two pairs of orbital bristles, hairs on sides of front short and sparse, frontal bristles descending to base of third antennal joint, cheeks over one-fourth as broad as the eye-height, facial ridges bristly on the lowest third to half, antennæ five-sixths as long as the face, the third joint three times as long as the second, arista thickened on the basal three-fifths, the penultimate joint shorter than broad; thorax gray pollinose, marked with four black vittæ, four sternopleural macrochætæ, scutellum bearing two long and two short pairs of marginal ones, the apical pair almost erect; abdomen on last three segments gray pollinose, their apices sometimes shining, the bristly hairs depressed; wings hyaline, third vein bearing two bristles at its base, hind crossvein and the fourth vein beyond the bend almost straight; calypteres white; length, 5 mm. Atlanta, Ga.,

[1] Zweif. Kais. Mus. Wien, VI, pp. 211, 212; 1893.

and Los Angeles Co., Cal. Two females collected by the writer. Type No. 3615, U. S. National Museum.....*pauciseta* n. sp.

3. With only three sternopleural macrochætæ, palpi yellow, third vein bearing from three to six bristles at its base; length, 8 to 10 mm. New Hampshire; and Austria. Two males and one female from Austria received from Brauer and Bergenstamm and by them labeled *Ceromasia florum* Macq.; these authors state that this is a synonym of *festinans* Meig., after examining the type of the latter.[1] (System. Besch. Eur. Zweif. Insekten, Vol. IV, p. 384; 1824: *Tachina. Masicera florum* Macquart, Annales Soc. Ent. France, p. 460; 1850.).....*festinans*[2] Meig.

With four sternopleural macrochætæ, palpi black, third vein bearing a single bristle at its base; length, 8 to 10 mm. Canada; Mass.; Illinois, and England. A specimen of each sex from England, received from E. Brunetti and by him labeled *Masicera myoidæa*. (Essai sur les Myodaires, p. 114; 1830: *Lydella.*).*myoidæa* Desv.

4. Middle tibiæ each bearing a single macrochæta on the front side near the middle, third vein bearing three bristles at its base. 5.

Middle tibiæ each bearing two or more macrochætæ on the front side near the middle, palpi yellow..... 6.

5. Palpi, legs, and abdomen, black; body slender, subshining; length, 5.5 to 6 mm. Mass., and Colorado. (Trans. Amer. Ent. Soc., Vol. XIX, p. 285; December, 1892.)....*tenthredinidarum* Town.

Palpi, femora, tibiæ, and apex of fourth segment of abdomen, yellow; body quite robust, opaque; black, the first two joints of antennæ, palpi, apex of proboscis, femora, tibiæ, and apex of fourth segment of abdomen, yellow; front of male one-half as wide as either eye, no orbital bristles, hairs on sides of front short and sparse, frontal bristles descending to base of third antennal joint, cheeks one-fourth as broad as the eye-height, facial ridges bristly on the lower two thirds, antennæ almost reaching the oral margin, the third joint three and one-third times as long as the second, arista thickened on the basal fourth; thorax gray pollinose and marked with four black vittæ, scutellum bearing three pairs of long marginal and a short apical pair of macrochætæ; abdomen on the first three segments subopaque gray pollinose, its hairs suberect and rather long; wings hyaline, the base tinged with gray, costal spine as long as crossvein at base of discal cell, hind crossvein nearly straight, fourth vein beyond the bend strongly concave, closing or almost closing the apical cell, calypteres white; front pulvilli slightly longer than the last

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[1] Zweif. Kais. Mus. Wien, V, p. 428; 1891.

[2] Front one and one-half width of eye, cheeks three-eighths the eye-height, arista thickened on basal two-thirds .....*festinans.*

Front of male two-thirds, of female five-sixths, width of eye, cheeks one-fifth the eye-height, arista thickened on basal two-fifths, otherwise as in *festinans*. N. J., Va., and La .....*celer* n. sp.

tarsal joint; length, 8 to 10 mm. Tifton, Ga., and Florida. Two male specimens. Type No. 3616, U. S. National Museum. *pulverea* n. sp.

6. Third vein bristly at least three-fourths of distance from the base to the small crossvein ..... 7.

Third vein bristly at most one-third of this distance, entire abdomen black; length, 6 to 11 mm. Grimsby, Canada; Mount Washington and Franconia, N. H.; Maryland; District of Columbia; northern Illinois, and Santa Cruz Mountains, Cal. (Trans. Amer. Ent. Soc., Vol. XIX, p. 286; Dec., 1892.) ..... *cufitchiæ* Town.—

7. Fourth and other segments of abdomen black; black, the palpi yellow; front of male three-fourths as wide as, of the female slightly wider than, either eye; two pairs of orbital bristles in the female, none in the male; sides of front and face white pollinose, cheeks over one-third as broad as the eye height, facial ridges bristly on the lowest third, antennæ five-sixths as long as the face, the third joint one and three fourths times as long as the second, arista thickened on the basal half, the penultimate joint shorter than broad; thorax thinly whitish pollinose, marked with four black vittæ, scutellum bearing three pairs of long marginal and a short apical pair of macrochætæ, abdomen shining, bases of the last three segments thinly whitish pollinose, venter not carinate in either sex; front pulvilli longer than the last tarsal joint; wings hyaline, the base tinged with gray, hind crossvein strongly curved, situated nearly midway between the small crossvein and the bend, calypteres white; length, 7 to 9 mm. White Mountains, New Hampshire. Four males and five females, collected by the late H. K. Morrison. Type No. 3617, U. S. National Museum ..... *chætoneura* n. sp.

Fourth segment of abdomen of female on the apical half yellow, her venter carinate, sides of front and face in both sexes deep golden yellow pollinose, third joint of antennæ two and one-third times as long as the second; length, 5 to 9 mm.; otherwise as in the above description of *chætoneura*. Mount Washington and White Mountains, New Hampshire. One male and two females, one from the former locality collected by Mrs. A. T. Slosson, the others by the late H. K. Morrison. Type No. 3618, U. S. National Museum ..... *aurifrons* n. sp.

Unrecognized species.—*M.(?) fulvipalpis* Bigot, Ann. Soc. Ent. France, p. 263; 1888: Rocky Mountains.

Genus ACEMYIA Desv.

Acemya Desvoidy, Essai sur les Myodaires, p. 202; 1830.
Aculocera Macquart, Annales Société Ent. France, p. 24; 1855.

The above synonymy was first determined by Rondani[1] from an examination of a typical specimen received from Macquart, and is

[1] Dipterologiæ Italicæ Prodromus, Vol. IV, p. 81; 1861.

repeated by Brauer and Bergenstamm.[1] Two species occur in our fauna, and in each there are three postsutural and two or three sternopleural macrochætæ:

Tibiæ and antennæ, except sometimes apex of second joint, black; apical cell closed, frontal bristles descending beneath base of second antennal joint; length, 6 to 7 mm. Beverly, Mass.; Tifton, Ga.; Georgetown, Fla.; Mobile, Ala.; Agricultural College, Miss.; St. Louis, Mo., and Los Angeles County, Cal. (Proc. Acad. Nat. Sci. Philadelphia, p. 311; Sept., 1895.) . . . *dentata* Coq.

Tibiæ and second antennal joint yellow, apical cell open, frontal bristles not descending to base of second antennal joint; black, the palpi, apex of proboscis, first two joints of antennæ, trochanters, apices of femora, and whole of tibiæ yellow; front of female as broad as either eye, the sides brownish gray pollinose, two pairs of orbital bristles, face white pollinose; antennæ reaching slightly below middle of face, the third joint one and one-half times as long as the second, arista thickened on the basal fourth, vibrissæ inserted three-fourths the length of the third antennal joint above the oral margin, two or three bristles above each, cheeks one-fifth as broad as the eye height; thorax gray pollinose, marked with four black vittæ; abdomen gray pollinose, a black dot at base of each hair, the hairs depressed, a marginal pair of macrochætæ on the second segment and a marginal row on the third and fourth; wings hyaline, third vein bearing one or two bristles near the base, the others bare, apical crossvein nearly straight, bend of fourth vein forming an obtuse angle; calypteres whitish; length, 4 mm. Santa Cruz Mountains, California. A single female specimen, collected by A. Koebele. Type No. 3620, U. S. National Museum . . *tibialis* n. sp.

Genus PSEUDOCHÆTA Coq.

Pseudochæta Coquillett, Proc. Acad. Nat. Sci. Philadelphia, p. 309; Sept., 1895.

Our species have two or three pairs of backwardly curving macrochætæ on the sides of the front in both sexes, and with two pairs of forwardly directed orbital bristles in the female, wanting in the male; four postsutural macrochætæ:

With only two sternopleural macrochætæ; black, including the palpi; third joint of antennæ in the male five, in the female three, times as long as the second; length, 5 to 7 mm. From the type specimen. Northern Illinois; Tifton, Ga.; Charlotte Harbor, Florida, and Santa Barbara County, Cal. (Proc. Acad. Nat. Sci. Phila., p. 310; Sept., 1895.) . . . . . *argentifrons* Coq.

With four sternopleural macrochætæ; black, the apex of scutellum, sides of second segment of abdomen, hind corners of the first and front corners of the third, yellow; front of female scarcely as wide as either eye, the sides and face silvery pollinose, frontal vitta

[1] Zweif. des Kais. Museum zu Wien, VI, p. 226; 1893.

obliterated in front of the middle by the meeting of the sides of the front, frontal bristles descending to the arista, cheeks one-tenth as broad as the eye height, vibrissæ inserted on a level with the front edge of the oral margin, facial ridges bristly on the lower three-fourths, antennæ almost as long as the face, the third joint six times as long as the second, arista thickened on the basal half, the penultimate joint slightly longer than broad; thorax gray pollinose, marked with four black vittæ; scutellum bearing two pairs of long and one of short marginal, also a short apical pair, of macrochætæ; abdomen subshining, last three segments thinly gray pollinose and with dark reflecting spots, the bristly hairs rather long, those in middle of dorsum suberect, second and third segments bearing only marginal macrochætæ; wings hyaline, third vein bearing two or three bristles near its base; calypteres white; middle tibiæ each bearing two or more macrochætæ on the front side near the middle, hind tibiæ evenly ciliate outwardly; length, 7 mm. District of Columbia. A single female specimen bred from a Pyralid found upon oak. Type No. 3622, U. S. National Museum.....*pyralidis* n. sp.

Genus PROSPHERYSA v. d. W.

Prospherysa van der Wulp, Biol. Cent.-Am., Diptera, Vol. II, p. 116; May, 1890.
Dexiophana Brauer and Bergenstamm, Zweif. Kais. Mus. Wien, V, p. 374; 1891.

Our single species is black, the apex of the proboscis and of the fourth segment of the abdomen, yellowish; three postsutural and three sternopleural macrochætæ, scutellum bearing three pairs of long marginal and a short apical pair, second and third segments of abdomen bearing discal and marginal, middle tibiæ each bearing two on the front side near the middle; length, 9 mm. Anglesea, N. J. (Biologia Cent.-Amer., Diptera, Vol. II, p. 117; May, 1890.) ...*æmulans* v. d. W.

Genus VANDERWULPIA Town.

Vanderwulpia Townsend, Trans. Amer. Ent. Soc., Vol. XVIII, p. 381; Dec., 1891.

Our two species have the antennal arista thickened to the middle and clothed with a pubescence which at the most is only slightly longer than its greatest diameter; three postsutural macrochætæ:

Abdomen reddish yellow; remainder of insect, except palpi and apex of proboscis, black; calypteres white, wings hyaline, anterior veins bordered with smoky, petiole of apical cell over one-half as long as the hind crossvein; length, 7 mm. Las Cruces, N. Mex. (Trans. Amer. Ent. Soc., Vol. XVIII, p. 381; December, 1891.).....*atrophopodoides* Town.

Abdomen and entire insect except palpi and lower part of face, black, calypteres and wings as in the preceding species, petiole of apical cell less than one-sixth as long as the hind crossvein; length, 10 mm. Texas. (Canadian Entomologist, Vol. XXIV, p. 172; July, 1892.).....*sequens* Town.

Genus HOUGHIA, new genus.

The characters of this genus may be gleaned from the table of genera given on previous pages, and the following description of the type species: Black, the palpi and apex of proboscis yellow; front of female five-sixths as wide as either eye, frontal bristles descending almost to middle of second antennal joint, two pairs of orbital bristles and two pairs of backwardly curving macrochætæ outside of the frontal bristles, cheeks one-twelfth as broad as the eye-height, four or five bristles above each vibrissæ, antennæ almost as long as the face, the third joint from four to five times as long as the second, arista thickened on the basal two-fifths, the penultimate joint broader than long; thorax gray pollinose, marked with four black vittæ, four postsutural and three sternopleural macrochætæ, scutellum bearing three long marginal pairs and a very short apical pair; abdomen shining, the last three segments except their apices whitish pollinose, each segment bearing marginal macrochætæ; middle tibiæ each bearing a single macrochæta on the front side near the middle, hind tibiæ outwardly subciliate; wings hyaline, first vein bristly except on its base and apex, third vein bristly almost to the small crossvein, hind crossvein at last third of distance from the small to the bend of the fourth, the latter not appendiculate, calypteres whitish; length, 6 to 7 mm. Tifton, Ga. Two females collected June and September 1, 1896, by Mr. G. R. Pilate, and transmitted by Dr. Garry deN. Hough, after whom the genus is named. Type No. 3623, U. S. National Museum..... *setipennis* n. sp.

Genus TACHINA Meig.

Tachina Meigen, in Illiger's Magazin für Insektenkunde, Vol. II, p. 280; 1803.
Eutachina Brauer and Bergenstamm, Zweif. Kais. Mus. Wien, IV, p. 98; 1889.
Chætotachina Brauer and Bergenstamm, loc. cit.
Tachinomyia Townsend, Trans. Amer. Ent. Soc., Vol. XIX, p. 96; April, 1892.

Eutachina was proposed for Tachina under the mistaken idea that the latter is identical with the genus Echinomyia. Chætotachina is given by its authors as a subgenus of Eutachina.[1] The synonymy of Tachinomyia is by the writer and is based on a cotype specimen of the type species. Our species have three sternopleural macrochætæ, and two or more on the front side of each middle tibia near the middle:

1. Apices of last three segments of abdomen shining black, tip of abdomen black, genitalia not or only slightly projecting beyond the tip of the fourth segment, frontal bristles descending on sides of face nearly halfway to the vibrissæ, facial ridges bristly almost to the lowest frontal bristles..... 2.

   Apices of last three segments of abdomen usually opaque gray pollinose, apex of scutellum and of abdomen usually yellow, genitalia of male projecting more than half the length of the

[1] Zweif. Kais. Mus. Wien, VI, p. 125; 1893.

fourth segment in the form of a claw, frontal bristles seldom descending on sides of face more than one-third of the distance to the vibrissæ, facial ridges bristly about three-fifths of distance from the vibrissæ to the lowest frontal bristles; length, 6 to 14 mm. Toronto, Canada; Franconia, N. H.; Springfield, Mass.; Clementon, N. J.; Ithaca, N. Y.; northern Illinois; Ames, Iowa; Cadet, Mo.; Brookings, S. Dak.; Colorado; Pullman, Wash.; Oregon, and California. (Trans. Amer. Ent. Soc., Vol. XIX, p. 96; April, 1892: *Tachinomyia:* from a cotype specimen. *Prosspherysa similis* Williston, North American Fauna, No. 7, p. 256; May 31, 1893: from a cotype specimen.) ..... *robusta* Town. —

2. Thorax bearing four postsutural macrochætæ, second and third segments of abdomen destitute of discal ones; length, 6 to 13 mm. Toronto, Canada; Franconia, N. H.; Massachusetts; New York, N. Y.; District of Columbia; West Virginia; Tifton, Ga.; Florida; Onaga, Kans.; Texas; Las Cruces, N. Mex.; West Cliff, Colo.; Evanston, Wyo.; Pullman, Wash.; Oregon, and California. (List of Dipterous Insects, Part IV, p. 767; 1849. *Tachina panætius* Walker, loc. cit. *Tachina pansa* Walker, loc. cit., p. 787. *Podotachina americana* Brauer and Bergenstamm, Zweif. Kais. Mus. Wien, V, p. 351; 1891. *Tachina clisiocampæ* Townsend, Psyche, Vol. VI, p. 83; May, 1891. *Tachina orgyiæ* Townsend, Trans. Amer. Ent. Soc., Vol. XIX, p. 284; December, 1892. *Achætoneura fernaldi* Williston, in Forbush and Fernald's The Gypsy Moth, p. 387; 1896. *Eutachina* sp., Brauer and Bergenstamm *in litt.*) ..... *mella* Walk. —

Thorax bearing only three postsutural macrochætæ, second and third segments of abdomen bearing discal macrochætæ; length, 7 to 10 mm. Toronto, Canada; White Mountains and Franconia, N. H.; Colorado; Washington; Los Angeles County, Cal.; Germany, and Austria. Two males and two females from Austria, received from Brauer and Bergenstamm and by them labeled *Chætotachina rustica* Meig.; also three males and two females from Germany, received from Zeller and by him labeled *Tachina larvarum*. (Diptera Succiæ, Muscidæ, p. 5; 1820. The following synonymy is by Rondani in Dipt. Ital., Vol. III, p. 200; 1859, and is repeated by Schiner in Faun. Aus., Vol. I, pp. 474, 475; 1862: *Tachina rittata* Macquart, Annales Soc. Entom. France, p. 377; 1854; also *flavipalpis*, p. 382; *ludibunda* and *rectinervis*, p. 383; *audens*, p. 385; *flavifrons*, p. 386; *pumila*, p. 387; *albifrons*, p. 389; and *alacer*, p. 390. The following is by the writer: *Tachina spinosula* Townsend, Trans. Amer. Ent. Soc., Vol. XVIII, p. 353; November, 1891. *Tachina tenthredinivora* Townsend, loc. cit., Vol. XIX, p. 285; December, 1892. *Chætotachina* sp., Brauer and Bergenstamm *in litt.*) .... *rustica* Fallen. —

Unrecognized species.—*T.*(?) *hybreas* Walker; Brit. Amer.

Genus TACHINOPSIS, new genus.

The following is a description of the type species: Black, the frontal vitta, first two joints of antennæ, and the palpi yellow; front of male two-thirds as wide as either eye, frontal bristles descending slightly below the arista, no orbital bristles, hairs on sides of front short and sparse, cheeks one-sixth as broad as the eye height, vibrissæ on a line with front edge of oral margin, ridges bristly on the lower three-fourths, antennæ six-sevenths as long as the face, third joint three and one half times as long as the second, arista thickened on the basal two-fifths, the penultimate joint nearly as broad as long, thorax gray pollinose, marked with four black vittæ, four postsutural and three sternopleural macrochætæ; scutellum bearing four marginal pairs; abdomen shining, bases of last three segments opaque gray pollinose, first three segments bearing marginal macrochætæ only; front pulvilli as long as the last tarsal joint, middle tibiæ each bearing two macrochætæ on the front side near the middle, hind tibiæ outwardly subciliate; wings hyaline, third vein bearing three bristles near its base, hind crossvein slightly beyond the middle between the small and the bend, last section of fifth vein almost as long as the preceding section; calypteres white; length, 7 mm. Washington. A single male specimen collected by Prof. O. B. Johnson. Type No. 3624, U. S. National Museum..... *mentalis* n. sp.

Genus EUTHERA Loew.

Euthera Loew, Diptera Amer. Septentrionalis Indig., Cent. VII, No. 85; 1864.

Our single species is black, the frontal vitta, middle of face, lower part of head, the palpi, and femora yellow; wings brown on the costal edge beyond the humeral crossvein, along the last two sections of the fifth vein, a fascia from costa over the hind crossvein and including the small crossvein, finally a fascia which fills the apex of the apical cell; length, 7 mm. Pottstown, Pa., and Tifton, Ga. (Loc. cit.) *tentatrix* Loew.

Genus DEMOTICUS Macq.

Demoticus Macquart, Annales Soc. Ent. France, p. 442; 1851.

1. Femora largely or wholly black..... 3.
   Femora and tibiæ yellow; three postsutural and three sternopleural macrochætæ..... 2.
2. Third vein bristly at least one-third of the distance from base to small crossvein, front of male five-sixths as wide as either eye, thorax, except the humeri, and the tarsi black; length, 9 to 11 mm. Philadelphia, Pa.; Colorado; California, and Washington. (Canadian Entomologist, Vol. XXVII, p. 127; May, 1895: *Drepanoglossa.*)..... *venatoris* Coq.

Third vein bearing only two bristles at the base, front of the male one and one-half times as wide as either eye; yellow, the third antennal joint, proboscis, center of dorsum of thorax, three spots on the pleura, and a dorsal spot on the third and fourth segments of the abdomen black; frontal bristles descending almost to apex of second antennal joint, third antennal joint twice as long as the second, arista thickened on the basal third, cheeks nearly one-half as wide as the eye height, proboscis slender, rigid, labella very small; second and third segments of abdomen bearing marginal macrochætæ, the fourth covered except on the basal third; wings hyaline, calypteres white; front pulvilli slightly shorter than the last tarsal joint; length, 11 mm. Denver, Colo. A single male specimen. Type in U. S. National Museum ..... *pallidus* n. sp.

3. Scutellum yellow, four postsutural and four sternopleural macrochætæ; black, the first two joints of the antennæ, the palpi, scutellum, and sides of the last three abdominal segments, also the apex of the fourth, yellow; front in female slightly wider than either eye, frontal bristles descending almost to tip of second antennal joint, antennæ nearly three-fourths as long as the face, the third joint one and one-fourth times as long as the second, arista thickened on the basal three-fifths, the penultimate joint one and one-half times as long as wide; head at base of antennæ slightly shorter than on its lower edge, vibrissæ inserted about half the length of the second antennal joint above the oral margin, three or four bristles above each; thorax gray pollinose, marked with four black vittæ; scutellum bearing four pairs of rather long marginal macrochætæ; abdomen thinly gray pollinose, second segment bearing a pair of marginal macrochætæ, the third bearing a marginal row, the fourth covered except on the basal fifth; middle tibiæ each bearing two long macrochætæ on the front side near the middle, the hind tibiæ outwardly subciliate; wings hyaline, third vein bearing about four bristles near its base, the others bare, apex of third vein midway between tip of second and the extreme wing tip, hind cross-vein at last third of distance from the small to the bend, the latter not appendiculate; calypteres white; length, 8 mm. Siskiyou Co., Cal. A female specimen bred from *Melitæa palla* by A. Koebele. Type No. 3626, U. S. National Museum. *melitææ* n. sp.

Scutellum black, probably four postsutural macrochætæ, but the anterior pair is wanting in the type specimen, four sternopleurals; black, the palpi, sides of first three segments of abdomen except the front corners, tibiæ, and apical third of under side of each femur yellowish; front of male one-half as wide as either eye, no orbital bristles, frontals descending to middle of second joint of antennæ, cheeks one-third as broad as the eye-

height, vibrissæ slightly above the level of front edge of oral margin, five or six bristles above each; antennæ five-sixths as long as the face, the third joint one and three-fourths times as long as the second, arista thickened on the basal two-fifths, the penultimate joint as broad as long, palpi linear, proboscis rigid, labella small but distinct; thorax gray pollinose, marked with five black vittæ, scutellum bearing five pairs of marginal macrochætæ; abdomen gray pollinose except the apices of the last three segments, first segment bearing marginal, the following two with discal and marginal macrochætæ; middle tibiæ each bearing two or more on the front side near the middle, hind tibiæ outwardly subciliate, front pulvilli longer than the last tarsal joint; wings hyaline, third vein bearing three bristles at the base, fourth vein rounded at the bend, beyond which it is nearly straight until a short distance before its apex, where it is strongly arcuate; calypteres white, margined with yellow; length, 13 mm. Blue Mountains, Washington. A single male specimen, collected July 15, 1896, by Prof. C. V. Piper. Type No. 3627, U. S. National Museum. ..... *piperi* n. sp.

Genus PARAPHYTO Coq.

Paraphyto Coquillett, Journal N. Y. Ent. Soc., Vol. III, p. 105; Sept., 1895.

1. First two segments of abdomen destitute of dorsal macrochætæ, scutellum bearing three marginal pairs, three postsuturals and two sternopleurals, third vein bristly about halfway to the small crossvein ..... 2.

   First two segments bearing dorsal, the second and third with discal and marginal macrochætæ, scutellum bearing five marginal pairs, four postsuturals and three sternopleurals, third vein bristly on the basal eighth before the small crossvein, abdomen subshining, thinly whitish pollinose, destitute of distinct black spots; black, including the palpi, the face and cheeks largely reddish; length, 13 mm. Laggan, Brit. Amer. (Can. Entomologist, Vol. XXIV, p. 68; March, 1892: *Trixa.*) ..... *gillettei* Town.

2. Abdomen subshining, thinly gray pollinose, destitute of distinct black spots; black, the first two joints of antennæ, facial depression, and palpi yellow; abdomen sometimes largely brownish-red; length, 11 to 13 mm. Ithaca, N. Y., and Agricultural College, Michigan. (Journal N. Y. Ent. Soc., Vol. III, p. 105; Sept., 1895.) ..... *chittendeni* Coq.

   Abdomen opaque gray pollinose, marked with three rows of shining black spots; black, the first two joints of antennæ, facial depression, and palpi yellow; front of female one and one-fourth times as wide as either eye, two pairs of orbital bristles, frontal bristles not descending below base of antennæ, sides of face at narrowest part each two-fifths as wide as the facial depression,

hairy one-half the distance from the lowest frontal bristle to the vibrissæ, the latter inserted slightly above the anterior edge of the oral margin, facial ridges bristly on the lowest sixth; antennæ three-fourths as long as the face, the third joint one and one-half times as long as the second, arista pubescent, thickened on the basal two-fifths, the penultimate joint shorter than broad, cheeks almost as wide as the eye height; thorax opaque gray pollinose, marked with three black vittæ; wings hyaline, calypteres white; length, 12 mm. Colorado; and Mesilla, N. Mex. Three female specimens, captured by Carl F. Baker and T. D. A. Cockerell. Type No. 3584, U. S. National Museum..... *opaca* n. sp.

Genus **PARACHÆTA**, new genus.

The principal characters of this genus have been given in the table of genera published on previous pages. The type species is black, the first two joints of antennæ, palpi, hind corners of thorax, and the scutellum yellow; sides of first three segments of abdomen sometimes tinged with yellowish; front of male one-half as wide as either eye, destitute of orbital bristles, frontal bristles descending to base of third antennal joint, cheeks one-fourth as wide as the eye height, vibrissæ inserted one-third the length of the second antennal joint above the anterior edge of the oral margin, facial ridges bristly on the lower two-thirds to three-fourths; antennæ four-fifths as long as the face, the third joint one-third as long as the second, arista thickened on the basal half, the penultimate joint scarcely longer than broad; thorax thinly gray pollinose, marked with four black vittæ, four postsutural and three sternopleural macrochætæ, scutellum bearing four pairs of long marginal; abdomen shining, destitute of pollen, no macrochætæ on the first two segments, only a marginal row on the third; hind tibiæ densely ciliate with scale-like bristles; wings hyaline, the bases brownish, calypteres brown; length, 13 mm. Ithaca and New York, N. Y. (Diptères Exotiques, Supplement I, p. 158; 1846: *Blepharipeza*. *Blepharipeza inermis* Bigot, Annales Soc. Ent. France, p. 91; 1888.) ..... *bicolor* Macq.

Genus **BLEPHARIPEZA** Macq.

Blepharipeza Macquart, Diptères Exotiques, Vol. II, Part II, p. 211 (51); 1843.

Rileya Brauer and Bergenstamm, Zweif. Kais. Mus. Wien, VI, p. 121; 1893. (*Non* Ashmead, Entomologica Americana, Vol. IV, p. 42; June, 1888. *Non* Howard, loc. cit., p. 80; July, 1888.)

Rileymyia Townsend, Entomological News, Vol. IV, p. 277; October, 1893.

The latter name was proposed to take the place of Rileya, which is preoccupied in the Hymenoptera. A comparison of specimens of *Rileya americana* (the type species of this genus), identified by Brauer and Bergenstamm, with specimens of *Blepharipeza leucophrys* (the type species of the latter genus), fails to disclose any difference of generic

valu'. Our two species have four postsutural and three sternopleura macrochætæ:

Abdomen wholly black; length, 11 to 13 mm. Franconia, N. H., and Washington. (Aussereuropäische Zweif. Insekten, Vol. II, p. 308; 1830: *Tachina. Blepharipeza rufipalpis* Macquart, Dipt. Exot., Vol. II, Part II, p. 212 (55); 1843. *Tachina latifrons* Walker, Insecta Saundersiana, p. 284; 1856.) ..... *leucophrys* Wied.

Abdomen reddish yellow, a black dorsal vitta; length, 10 to 14 mm. Toronto, Canada; Oswego and New York, N. Y.; Colorado, and California. (Diptera Amer. Septen. Indigena, Centuria X, No. 67; 1872. *Blepharipeza fulvipes* Bigot, Ann. Soc. Entomol. France, p. 92; 1888. *Blepharipeza exul* Townsend, Canadian Entomologist, Vol. XXIV, p. 64; March, 1892. *Blepharipeza rufescens* Townsend, Trans. Am. Ent. Soc., Vol. XIX, p. 90; April, 1892. *Rileya americana* Brauer and Bergenstamm, Zweif. Kais. Mus. Wien, VI, p. 204; 1893: also *in litt.*) .... *adusta* Loew.

Genus WINTHEMIA Desv.

Winthemia Desvoidy, Essai sur les Myodaires, p. 173; 1830.
Chetoliga Rondani, Dipterologiæ Italicæ Prodromus, Vol. I, p. 66; 1856.

This synonomy has already been published by Brauer and Bergenstamm.[1] Desvoidy (loc. cit.) gives the *Musca quadripustulata* Fabr. as the type of Winthemia; and this species is included by Rondani in his genus Chetoliga (loc. cit., Vol. III, pp. 105 and 108):

1. Thorax bearing four postsutural and two sternopleural macrochætæ ..... 2.

Thorax bearing three postsutural and three sternopleural macrochætæ; black, the palpi yellow, frontal vitta dark brown; front in male slightly broader than either eye; antennæ six-sevenths as long as the face, third joint nearly three times as long as the second, arista thickened nearly to the middle, cheeks one-sixth as broad as the eye height; thorax gray pollinose, marked with four black vittæ; scutellum bearing four marginal pairs of macrochætæ, of which the second and apical pairs are shorter than the others; abdomen wholly gray pollinose, the bristly hairs rather long and suberect, second segment bearing a marginal pair, the third a marginal row of macrochætæ, those on the fourth segment scarcely longer than the bristly hairs; hind tibiæ outwardly ciliate and with a much longer bristle near the middle, front pulvilli as long as the last tarsal joint; wings hyaline, fourth vein beyond the bend almost straight; calypteres white; length, 7 mm. Maryland. A single male specimen, collected by the writer in June. Type No. 3628, U. S. National Museum ..... *obscura* n. sp.

[1] Zweif. Kais. Mus. Wien, VI, p. 239; 1893.

2. Palpi, scutellum, and apex of abdomen, black; third antennal joint in the female three times as long as the second, hind tibiæ outwardly near the middle bearing a bristle which is nearly twice as long as the adjacent ones; length, 7 mm. Los Angeles County, Cal. (Ann. Soc. Entomol. France, p. 258; 1888: *Chætolyga.*) ..... *nigrifacies* Bigot.

Palpi, scutellum, and apex of abdomen, yellowish; third antennal joint in the female about twice as long as the second, no longer bristles on outer side of the hind tibiæ near the middle; females usually with a marginal pair of macrochætæ on the second abdominal segment, which is generally wanting in the males; length, 6 to 12 mm. London, Canada; White Mountains and Franconia, N. H.; Agawam, Mass.; Delaware County, Pa.; Ithaca, N. Y.; Chester, Pa.; District of Columbia; Portsmouth, Va.; Shreveport, La.; Illinois; Agricultural College, Mich.; St. Louis, Mo.; Washington, and Germany. Four males from Germany received from Zeller and by him labeled *Nemoræa 4-pustulata.* (Entom. Systematica, Vol. IV, p. 324; 1794: *Musca.* The following synonymy is by Schiner in Faun. Austriaca, Vol. I, p. 454: *Winthemia cinerea* Desvoidy, Ann. Soc. Entomol. France, p. 270; 1847. The following is by the writer: *Exorista leucaniæ* Kirkpatrick, Ohio Agricultural Report for 1860, p. 757; 1861. The following is given in Osten Sacken's Catalogue: *Exorista ostensackenii* Kirkpatrick, loc. cit. *Senometopia militaris* Walsh, Trans. Ill. State Agric. Soc., Vol. IV, p. 367; September, 1861. The following is by the writer: *Exorista europiæ* Riley MS., from the proposed type specimen. *Tachina deilephilæ* Osten Sacken, Canadian Entomologist, Vol. XIX, p. 164; September, 1887. *Exorista infesta* Williston, in Fourteenth Report State Ent. Illinois, p. 65; 1885. *Chætolyga rufonotata* Bigot, Ann. Soc. Entomol. France, p. 257; 1888. *Chætolyga rufopicta* Bigot, loc. cit., p. 259. *Exorista ciliata* Townsend, Trans. Amer. Ent. Soc., Vol. XVIII, p. 363; Dec., 1891. *Exorista platysamiæ* Townsend, loc. cit., Vol. XIX, p. 288; Dec., 1892. *Exorista datanæ* Townsend, loc. cit. *Chætolyga deilephila* O. S., Brauer and Bergenstamm *in litt.*) ..... *quadripustulata* Fabr.

Genus **MUSCOPTERYX** Town.

Muscopteryx Townsend, Canadian Entomologist, Vol. XXIV, p. 170; July, 1892.

Our species is black, including the palpi; three postsutural and three sternopleural macrochætæ; length, 9 mm. Missouri. (Loc. cit, p. 171.) *chætosula* Town.

Genus PARADIDYMA Br. and Berg.

Paradidyma Brauer and Bergenstamm, Zweif. Kais. Mus. Wien, V, p. 382; 1891.
Atrophopoda Townsend, Trans. Amer. Ent. Soc., Vol. XVIII, p. 373; December, 1891.
Lachnomma Townsend, loc. cit., Vol. XIX, p. 103; May, 1892.

The synonymy of Lachnomma with Paradidyma is given with a query by Brauer and Bergenstamm.[1] In the Trans. Amer. Ent. Soc. for 1895, page 77, Mr. Townsend suggests that the supposed type species of his two genera, Atrophopoda and Lachnomma, are but the opposite sexes of one and the same species, and the specimens in the National Museum fully establish the accuracy of this supposition. Our single species is black, the palpi and apex of proboscis yellowish; three postsutural and three sternopleural macrochætæ; length, 6 to 9 mm. Springfield, Mass.; northern Illinois; District of Columbia; Georgia; Agricultural College, Miss.; Texas; Custer County, Colo.; Las Cruces, N. Mex.; and Kern County, Cal. (Trans. Amer. Ent. Soc., Vol. XVIII, p. 374; December, 1891: *Atrophopoda. Lachnomma magnicornis* Townsend, loc. cit., Vol. XIX, p. 104; May, 1892. ?Paradidyma sp., Brauer and Bergenstamm *in litt.*) ..... *singularis* Town.

Genus ATROPHOPALPUS Town.

Atrophopalpus Townsend, Entomological News, Vol. III, p. 130; June, 1892.

Our single species is black, the palpi yellowish; three postsutural and two sternopleural macrochætæ; length, 4⅜ to 7 mm. Lake Worth, Fla. (Loc. cit., p. 131.) ..... *angusticornis* Town.

Genus METACHÆTA Coq.

Metachæta Coquillett, Journal N. Y. Ent. Soc., Vol. III, p. 98; September, 1895.

Our single species is black, the palpi and apex of proboscis yellow; body not pollinose; three postsutural and two sternopleural macrochætæ; length, 4 to 5 mm. From the type specimen. Toronto, Canada; Franconia, N. H.; northern Illinois; Colorado, and Santa Cruz Mountains, California. (List of Dipterous Insects, Part IV, p. 795; 1849: *Tachina. Metachæta atra* Coquillett, Journal N. Y. Ent. Soc., Vol. III, p. 99; September, 1895.) ..... *helymus* Walk.

Genus PHORICHÆTA Rond.

Scopolia Desvoidy, Essai sur les Myodaires, p. 268; 1830. (*Non* Huebner; 1816.)
Phorichæta Rondani, Dipterologiæ Italicæ Prodromus, Vol. IV, p. 8; 1861.

The latter name was proposed to take the place of Scopolia, which is preoccupied in the Lepidoptera. Our species has the sides of the front and the body shining black, and destitute of pollen; three postsutural and two or three sternopleural macrochætæ; wings hyaline, the veins and crossveins sometimes bordered with brown; length 4 to 6 mm.

[1] Zweif. Kais. Mus. Wien, VI, p. 193; 1893.

White Mountains and Franconia, N. H.; Beverly, Mass.; northern Illinois; Colorado; British Columbia; Easton, Wash., and Placer and Los Angeles counties, Cal. (In Cook's Notes on Injurious Insects, p. 5; 1884: *Scopolia*.) ..... *sequax* Will.

Unrecognized species.—P.? (*Scopolia*) *lateralis* Macquart; America (probably South America).

Genus CHÆTOPLAGIA Coq.

Chætoplagia Coquillett, Journal N. Y. Ent. Soc., Vol. III, p. 98; September, 1895.

Our single species is black, the second antennal joint and the palpi yellow; three postsutural and three sternopleural macrochætæ; wings blackish along the veins of the costal half; length, 7 mm. District of Columbia and southern Illinois. (Loc. cit.) ..... *atripennis* Coq.

Genus METOPIA Meig.

Metopia Meigen, in Illiger's Magazin für Insektenkunde, Vol. II, p. 280; 1803.
Ophelia Desvoidy, Essai sur les Myodaires, p. 120; 1830.

This synonymy is given by Macquart[1] and repeated by Schiner[2] and by Brauer and Bergenstamm.[3] Our single species is black, including the palpi, sides of abdomen sometimes partly yellow; three postsutural and two sternopleural macrochætæ; length 6 to 8 mm. White Mountains, New Hampshire; Beverly, Mass.; District of Columbia; northern Illinois; Kenedy, Tex.; Colorado; Los Angeles County, Cal.; Washington; France; Germany, and Austria. A male from Austria, from the old Schiner collection, received from Brauer and Bergenstamm and by them labeled *Metopia leucocephala* (Rossi) Schiner; three males from Germany, received from Zeller, and by him labeled *Metopia leucocephala;* also one specimen of each sex from France, received from H. du Buysson, and labeled as above. (Fauna Etrusca, Vol. II, p. 1501; 1791: *Musca. Musca labiata* Fabricius,[4] Entomologia Systematica, Vol. IV, p. 329; 1794. *Araba squamipallens* Desvoidy, Essai sur les Myodaires, p. 130; 1830. *Araba grisea* Desvoidy, loc. cit., p. 131. *Degeeria lateralis* Macquart, Dipt. Exot., Sup. III, p. 208 [48]; 1847. *Metopia luggeri* Townsend, Can. Entom., Vol. XXIV, p. 69; March, 1892.) ..... *leucocephala* Rossi.

Genus ARABA Desv.

Araba Desvoidy, Essai sur les Myodaires, p. 127; 1830.
Eumetopia Brauer and Bergenstamm, Zweif. Kais. Mus. Wien, IV, p. 114; 1889.

This synonymy has already been acknowledged by the last-mentioned authors.[5] Our single species is wholly black; front in male

[1] Annales Soc. Ent. France, p. 436; 1850.
[2] Fauna Austriaca, Vol. I, p. 498; 1862.
[3] Zweif. Kais. Mus. Wien, VI, p. 234; 1893.
[4] This synonymy is given by Meigen and repeated by most subsequent authors. The synonymy of *squamipallens* is according to Schiner; the remainder is by the writer.
[5] Zweif. Kais. Mus. Wien, V, p. 359; 1891.

silvery, including the vitta, in the female grayish pollinose, the vitta brownish; orbital bristles present in both sexes; three postsutural and two sternopleural macrochætæ, thorax of male grayish pollinose except on the front end, not vittate, that of the female gray pollinose and marked with four black vittæ; abdomen gray pollinose, last three segments black on the hind margins, or each marked with three black spots; length, 4 to 6 mm. Northern Illinois; Colorado, and Los Angeles County, Cal. (Journ. N. Y. Ent. Soc., Vol. III, p. 103; September, 1895.) ..... *tergata* Coq.

Genus OPSIDIA Coq.

Opsidia Coquillett, Journal N. Y. Ent. Soc., Vol. III, p. 102; September, 1895.

Our single species is black, the first two joints of the antennæ and the palpi yellow; three postsutural and two or three sternopleural macrochætæ; length, 9 mm. From the type specimen. Massachusetts; Atlantic City, N. J., and Iowa. (Loc. cit.) ..... *gonioides* Coq.

Genus HILARELLA Rond.

Hilarella Rondani, Dipterologiæ Italicæ Prodromus, Vol. I, p. 70; 1856.
Eumacronychia Townsend, Trans. Amer. Ent. Soc., Vol. XIX, p. 98; May, 1892.
Gymnoprosopa Townsend, loc. cit., p. 108.

This synonymy is by the writer. All of our species have three postsutural and two sternopleural macrochætæ:

1. Tip of abdomen black, scutellum bearing three pairs of marginal macrochætæ ..... 2.
   Tip of abdomen and the genitalia yellow, scutellum bearing only two pairs of marginal macrochætæ, abdomen gray pollinose, hind margins of the first three segments black, third vein bristly at least halfway to the small crossvein, arista thickened on the basal half; length, 6 to 8 mm. From a cotype specimen received from Mr. Townsend. Las Cruces, N. Mex., and Los Angeles County, Cal. (Trans. Amer. Ent. Soc., Vol. XIX, p. 99; May, 1892: *Eumacronychia.*) ..... *decens* Town.
2. Third vein bristly at least halfway to the small crossvein ..... 3.
   Third vein bearing from one to four bristles near its base ..... 4.
3. Arista thickened on at least the basal three-fifths, abdomen gray pollinose, the first three segments each marked with from one to three black spots, hind margin of the fourth segment also black, antennæ usually but not always yellow; length, 5 to 9 mm. Franconia, N. H.; New Bedford, Mass.; Avalon and Angelsea, N. J., and northern Illinois. From the type specimen. (Journal N. Y. Ent. Soc., Vol. III, p. 106; September, 1895: *Gymnoprosopa.*) ..... *fulvicornis* Coq.
   Arista at most thickened on the basal two-fifths, abdomen shining

black, the bases of the last three segments gray pollinose; length, 4 to 5 mm. Southern Illinois; Atlanta, Ga., and Florida. (Trans. Amer. Ent. Soc., Vol. XIX, p. 109; May, 1892: *Gymnoprosopa*. *Gymnoprosopa argentifrons* Townsend, loc. cit. *Gymnoprosopa clarifrons* Townsend, loc. cit.) ..... *polita* Town.

4. Third vein bearing three or four bristles near its base, the outermost at the first fifth of distance to the small crossvein, abdomen gray pollinose and marked with five rows of black spots, the two outer ones situated on the lateral margins; arista thickened on the basal two-fifths; length, 5 to 6 mm. Clementon, N. J.; Tifton, Ga.; Colorado, and Los Angeles Co., Cal. (Diptera Scandinaviæ, Vol. III, p. 1213; 1844: *Miltogramma*.) ... *siphonina* Zett.

Third vein bearing a single bristle near its base, arista thickened on the basal three-fourths ..... 5.

5. Frontal vitta next the antennæ almost as wide as either side of the front, abdomen gray pollinose, the first segment and three large spots on the second and third shining black; black; face white, sides of front yellowish pollinose, front in the male one-half, in the female as wide as, either eye, two pairs of orbital bristles in both sexes, antennæ four-fifths as long as the face, the third joint four times as long as the second, penultimate joint of arista broader than long, cheeks scarcely one-sixth as broad as the eye height, vibrissæ fully developed, only two or three bristles above each; thorax gray pollinose, marked with four black vittæ, scutellum gray pollinose, the sides black, wings hyaline, calypteres white, macrochætæ of abdomen short and depressed, only marginal; length, 4 to 5 mm. Southern Illinois and Colorado. One male and two females, the former collected by Mr. Charles Robertson, the latter by Mr. Carl F. Baker. Type No. 3634, U. S. National Museum ..... *aristalis* n. sp.

Frontal vitta next the antennæ less than one-third as wide as either side of the front; black, the antennæ, face, palpi, and first three segments of abdomen yellow, abdomen shining except the whitish pollinose bases of the last three segments; front in both sexes almost as wide as either eye, antennæ in the male five-sixths, in the female three-fourths, as long as the face, the third joint in the male six, in the female four, times as long as the second, thorax gray pollinose, not vittate, wings hyaline, calypteres white; length, 4 to 5 mm. Holly Springs, Miss. Three males and one female, collected by F. W. Mally ... *rufiventris* n. sp.

Unrecognized species.—*H.* (*Eumacronychia*) *elita* Townsend, Trans. Amer. Ent. Soc., Vol. XIX, p. 100; 1892. Las Cruces, N. Mex.

Genus TRICOGENA Rond.

Tricogena Rondani, Dipterologiæ Italicæ Prodromus, Vol. I, p. 88; 1856.
Frauenfeldia Egger, Verhand. Kais.-Kön. Zool.-Botan. Gesell., Vol. XV, p. 297; 1865.

This synonymy is according to Brauer and Bergenstamm:[1]

Palpi yellow, insect elsewhere black; front of female one and one-fourth times as wide as either eye, two pairs of orbital bristles, frontal bristles descending to the arista, sides of face each at narrowest part one-half as wide as the facial depression, each bearing two downwardly curving macrochætæ, the lowest of which is nearly on a level with lower ends of eyes, cheeks two-fifths as wide as the eye-height, vibrissæ slightly above the oral margin, one or two bristles above each; antennæ four-fifths as long as the face, the third joint only slightly longer than the second, arista thickened on the basal fourth, the penultimate joint broader than long; thorax whitish pollinose, not distinctly vittate, three postsutural and two sternopleural macrochætæ, scutellum bearing three long marginal pairs, abdomen shining, the bases of the second and third segments whitish pollinose, first three segments bearing marginal macrochætæ; middle tibiæ each bearing two on the front side near the middle; wings whitish hyaline, the costal edge brownish, third vein bearing two bristles at the base, hind crossvein midway between the small and the bend, petiole of apical cell slightly shorter than the small crossvein, calypteres white; length, 5 mm. Colorado. A female specimen. Type No. 3635, U. S. National Museum. *costalis* n. sp.

Palpi black, insect elsewhere black; front of female almost as wide as either eye, frontal bristles descending slightly below base of first antennal joint, sides of face at narrowest part each one-fifth as wide as the median depression, each bearing a row of macrochætæ and scattered black hairs, cheeks nearly one-third as broad as the eye height, antennæ three-fourths as long as the face, the third joint twice as long as the second; body with a strong brassy tinge, three sternopleural macrochætæ, bases of last three segments of abdomen whitish pollinose; wings hyaline, the portion in front of fifth vein tinged with yellowish, especially along the veins and crossveins, third vein bristly almost to the small crossvein; length, 7 mm., otherwise as in the above description of *costalis*. Franconia, N. H. A single female specimen collected by Mrs. A. T. Slosson. Type No. 3636, U. S. National Museum ..... *setipennis* n. sp.

[1] Zweif. Kais. Mus. Wien, VI, p. 238; 1893.

Genus BRACHYCOMA Rond.

Brachycoma Rondani, Dipterologiæ Italicæ Prodromus, Vol. I, p. 69; 1856.
Laccoprosopa Townsend, Trans. Amer. Ent. Soc., Vol. XVIII, p. 365; December, 1891.
Sarcotachinella Townsend, loc. cit., Vol. XIX, p. 110; 1892.

A comparison of a cotype specimen of *Laccoprosopa sarcophagina* (the type species of this genus) kindly submitted by Mr. Charles Robertson, of Carlinville, Ill., with a specimen of *Brachycoma devia* (the type species of the latter genus) received from and identified by Brauer and Bergenstamm, fails to disclose any difference of generic importance; and the same is true in regard to specimens that I identify as *Sarcotachinella intermedia* Town. All of our species have only three postsutural macrochætæ:

1. Fourth segment of abdomen wholly black ..... 3.
   Fourth segment largely yellow, abdomen destitute of discal macrochætæ, scutellum bearing three marginal pairs, bend of fourth vein appendiculate ..... 2.
2. Sides of face each bearing a row of macrochætæ, palpi black; length, 8 to 10 mm. Southern California. (Entomological News, Vol. V, p. 172; June, 1894.) ..... *davidsoni* Coq.
   Sides of face bearing short bristly hairs not disposed in rows, palpi yellow; black, the palpi and fourth abdominal segment yellow, antennæ more or less reddish; front in the male one-half, in the female almost, as wide as either eye, three pairs of orbital bristles in the female, wanting in the male; cheeks two-thirds as wide as the eye height; antennæ five-sixths as long as the face, the third joint one and two-thirds times as long as the second, arista thickened on the basal fourth; abdomen gray pollinose, the first three segments marked with a black dorsal vitta and two subdorsal rows of black spots situated on the hind margins of the segments; second segment bearing a small marginal pair of macrochætæ, the third and fourth each with a marginal row; front pulvilli of male slightly longer than, of the female two-thirds as long as, the last tarsal joint; wings hyaline, third vein bristly almost halfway to the small cross-vein, calypteres white; length, 7 to 8 mm. Connecticut and Virginia. A single specimen of each sex, that from Virginia collected by Theodore Pergande May 23, 1884. Type No. 3638, U. S. National Museum ..... *apicalis* n. sp.
3. Second and third segments of abdomen destitute of discal macrochætæ, thorax marked with three or five black vittæ ..... 4.
   Second and third segments bearing discal macrochætæ, thorax marked with four black vittæ; black, the palpi and base of third antennal joint yellow; front in female three-fourths as wide as either eye, two pairs of orbital bristles, antennæ four-fifths as long as the face, the third joint scarcely longer than

the second, arista thickened on the basal fourth, sides of face each bearing a single row of macrochætæ, cheeks one-fourth as wide as the eye height; scutellum bearing three pairs of long marginal macrochætæ; abdomen opaque gray pollinose, with darker reflecting spots, first and second segments with a marginal pair, second and third each with a discal pair, third with a marginal row, and the fourth with three rows of macrochætæ; wings hyaline, third vein bristly halfway to the small crossvein, apical cell short petiolate, calypteres white; length, 6 mm. San Diego, Tex. A female collected May 2, 1895, by E. A. Schwarz. Type No. 3639, U. S. National Museum. *pulverea* n. sp.

4. Scutellum bearing only two pairs of long marginal macrochætæ, costal spine much longer than the small crossvein; length, 8 to 9 mm. Westville, N. J.; Potomac Creek, Va.; Tifton, Ga., and Florida. (Trans. Amer. Ent. Soc., Vol. XIX, p. 111; May, 1892: *Sarcotachinella.*) ..... *intermedia* Town.

Scutellum bearing three pairs of long marginal macrochætæ, costal spine noticeably shorter than the small crossvein; length, 6 to 8 mm. Cumberland County, N. J., and southern Illinois. (Trans. Amer. Ent. Soc., Vol. XVIII, p. 366; December, 1891: *Laccoprosopa.*) ..... *sarcophagina* Town.

Unrecognized species.—B.(?) *macropogon* Bigot, Ann. Soc. Ent. France, p. 259; 1888. California.

Genus EUTHYPROSOPA Town.

Euthyprosopa Townsend, Trans. Amer. Ent. Soc., Vol. XIX, p. 106; May, 1892.

Our single species is black, the antennæ, middle of face, lower part of head, the palpi, corners of thorax, scutellum, hind margin of each segment of abdomen, apices of femora and the tibiæ, yellow; three postsutural and two sternopleural macrochætæ; length, 7 mm. From a cotype specimen. Las Cruces, N. Mex. (Loc. cit., p. 107.) *petiolata* Town.

Genus GONIA Meig.

Gonia Meigen, in Illiger's Magazin für Insektenkunde, Vol. II, p. 280; 1803.
Rhedia Desvoidy, Essai sur les Myodaires, p. 74; 1830.
Reaumuria Desvoidy, loc. cit., p. 79.
Isomera Desvoidy, Annales Soc. Ent. France, p. 315; 1851.
Pissemya Desvoidy, loc. cit., p. 318.

Desvoidy proposed the name Rhedia for the genus Gonia, erroneously stating that the latter term had been previously used in Conchology; and in the Annales Soc. Entomol. France, second series, p. 309, he states that his genus Reaumuria contains the males, and Rhedia the females, of the same species. The synonymy of Isomera is by Schiner,[1] and that of Pissemya is by Brauer and Bergenstamm.[2]

[1] Fauna Austriaca, Vol. I, p. 441; 1862.
[2] Zweif. Kais. Mus. Wien, VI, p. 235; 1893.

All of our species have four postsutural and four sternopleural macrochaetæ, and at most with only two marginal macrochaetæ on the first segment of the abdomen; hind tibiæ outwardly ciliate, two pairs of orbital bristles in both sexes:

1. Third joint of antennæ, except sometimes the base, black..... 2.
   Third joint of antennæ deep yellow; otherwise as in *capitata:* length, 11 to 13 mm. Maryland; St. Louis, Mo., and Georgia. (Canadian Entomologist, Vol. XIX, p. 10; January, 1887. *Gonia sagax* Townsend, Canadian Entomologist, Vol. XXIV, p. 65; March, 1892.).....*senilis* Will.
2. Viewed from the side, the head projects in front of the eye only slightly more than the horizontal diameter of the eye, and is sparsely covered with bristly hairs; sides of front, when viewed from behind, shining, destitute of pollen except next the eyes; abdomen black, the sides sometimes partly or wholly reddish or yellow, bases of last three segments gray pollinose; length, 9 to 14 mm. Toronto, Canada; Beverly, Mass.; Oswego, N. Y.; District of Columbia; North Carolina; Georgia; Detroit, Mich.; Illinois; Ames, Iowa; Missouri; Sunnyside, Ark.; Kansas; Texas; Colorado; California; Pullman, Wash., and Austria. A male specimen from Austria received from Brauer and Bergenstamm and by them labeled *Gonia capitata* DeGeer.[1] (Memoires servir l'Histoire Insectes, Vol. VI, p. 12; 1776: *Musca. Gonia frontosa* Say, Journal Acad. Nat. Sci. Phila., Vol. VI, p. 175; 1829. *Gonia philadelphica* Macquart, Diptères Exotiques, Vol. II, Part III, p. 208 [51]; 1842. *Gonia albifrons* Walker, List of Dipterous Insects, Part IV, p. 798; 1849. *Gonia exul* Williston, Can. Entomologist, Vol. XIX, p. 11; Jan., 1887. *Gonia sequax* Williston, loc. cit., p. 12.).....*capitata* DeGeer.
   Viewed from the side, the head projects in front of the eye almost twice the horizontal diameter of the eye and is densely covered with bristly hairs; sides of front when viewed from behind wholly covered with white pollen; black, the front, including the vitta, the face, cheeks, palpi, humeri, hind end of thorax, scutellum, and sides of the first three segments of the abdomen except the hind margin of the third, yellow; front in profile only slightly convex, almost at right angles to the occiput, in the male two and one-half times as wide as either eye, frontal bristles descending to base of second antennal joint, two or

[1] The synonymy of this species in Europe is very uncertain and unsatisfactory. It will doubtless be found that *ornata* Meigen and *fasciata* Meigen are but colorational forms of *capitata* DeGeer. Our specimens of the latter from this country show every possible gradation from those with the abdomen wholly black to those that have it yellow and marked with a narrow black dorsal vitta. A female having the abdomen wholly black except a small yellowish spot on each side of the second segment was taken united in coition to a male in which the sides of the first three segments were almost wholly yellowish.

three irregular rows of macrochætæ on the outer side of each row, the front near the eyes densely covered with rather long bristly hairs, sides of face each one and one-half times as wide as the median depression, densely covered with rather long black bristly hairs which are less numerous along the facial ridges, the latter bare except that there are two or three bristles above the vibrissæ, cheeks two-thirds as broad as the eye height, antennæ almost as long as the face, the third joint six times as long as the second, arista thickened to the tip, the penultimate joint as long as the last one; thorax whitish pollinose, marked with four black vittæ; scutellum bearing three pairs of long marginal and a very short apical pair of macrochætæ; abdomen wholly covered with whitish pollen, the hairs rather long and suberect, first two segments each bearing a marginal pair, the third with a marginal row, the fourth covered on its apical half with macrochætæ; front pulvilli of male three-fourths as long as the last tarsal joint; wings hyaline, third vein bristly one-third of distance to the small crossvein, hind crossvein arcuate, its posterior end slightly nearer the wing margin than to the small crossvein, calypteres white; length, 14 mm. Los Angeles Co., Cal. A male specimen captured by the writer in April. Type No. 3640, U. S. National Museum. . . *turgida* n. sp.

Unrecognized species.—*G. porca* Williston, Canadian Entomologist, Vol. XIX, p. 10; 1887. Mount Hood, Oreg.

Genus SPALLANZANIA Desv.

Spallanzania Desvoidy, Essai sur les Myodaires, p. 78; 1830.
Cnephalia Rondani, Dipterologiæ Italicæ Prodromus, Vol. I, p. 62; 1856.
Acroglossa Williston, in Scudder's Butterflies of New England, Vol. III, p. 1916; 1889.
Pseudogonia Brauer and Bergenstamm, Zweif. Kais. Mus. Wien, IV, p. 100; 1889.

Brauer and Bergenstamm have already placed Spallanzania, Cnephalia and Pseudogonia as subgenera of one genus,[1] and Mr. F. H. Snow has united these subgenera into one genus.[2] The synonymy of Acroglossa is by the writer.[3] Our species are black, the palpi, scutellum, and sometimes the sides and apex of abdomen and the first two joints of antennæ, yellow; four postsutural and four or five sternopleural macrochætæ; two pairs of orbital bristles in the female, wanting in the male:

1. Facial depression as wide as either side of face, bristles on the latter not arranged in rows. . . . . 2.

Facial depression twice as wide as either side of face, bristles on the latter arranged in two rows, pollen on sides of front yellowish, on the face white; third joint of antennæ in the male three, in

[1] Zweif. Kais. Mus. Wien, VI, p. 214; 1893.
[2] Kansas University Quarterly, Vol. III, p. 181; January, 1895.
[3] Psyche, Vol. VII, p. 261; July, 1895.

the female one and one-half, times as long as the second; penultimate joint of arista in the male four times, in the female slightly over twice, as long as broad; length, 10 to 12 mm. Franconia, N. H.; Delaware County, Pa.; Maryland; northern Illinois, and Tifton, Ga. (In Scudder's Butterflies of New England, Vol. III, p. 1917; 1889: *Acroglossa. Pseudogonia ruficauda* Townsend, Can. Entomologist, Vol. XXIV, p. 66; March, 1892. *Pseudogonia obsoleta*[1] Townsend, loc. cit.).... *hesperidarum* Will.

2. Third joint of antennæ in the male from two to two and three-fourths, in the female from one to one and one-half, times as long as the second; penultimate joint of arista in the male from one and one-half to four, in the female one and one-fourth, times as long as broad; length, 11 to 12 mm. North Carolina; Georgia; Fernandina, Fla., and Austria. A female from Austria received from Brauer and Bergenstamm and by them labeled *Cnephalia bisetosa*[2] B. B. (Diptera Sueciæ, Muscidæ, p. 11; 1820: *Tachina*. The following synonymy is by Desvoidy in Annales Soc. Entomol. France, p. 317; 1851: *Spallanzania gallica* Desvoidy, Essai sur les Myodaires, p. 79; 1830. The following is by Kowarz in Wiener Ent. Zeitung, Vol. VII, p. 6; January 31, 1888: *Gonia nudifacies* Macquart, Diptères Nord France, Vol. V, p. 179; 1833. *Isomera parisiaca* Desvoidy, Annales Soc. Entomol. France, p. 315; 1851. *Gonia cognata* Rondani, Dipt. Italicæ Prod., Vol. III, p. 38; 1859. *Spallanzania alpestris* Rondani, loc. cit., Vol. IV, p. 155; 1861. The following is by the writer: *Cnephalia pansa* Snow, Kansas University Quarterly, Vol. III, p. 182; January, 1895.)..... *hebes* Fall.

Third joint of antennæ in the male eight times as long as the second, penultimate joint of his arista four times as long as broad; black, the palpi and scutellum yellow; front of male twice as wide as either eye, the sides and face whitish pollinose and wholly covered with short macrochætæ except a narrow space outside of the facial ridges, frontal bristles short, descending to the arista; cheeks slightly over one-half as broad as the eye height, facial ridges bristly on the lower four-fifths, antennæ seven-eighths as long as the face, arista thickened almost to the tip; thorax gray pollinose, marked with four black vittæ, scutellum bearing three long marginal pairs and a short apical pair of macrochætæ, abdomen gray pollinose and with reflecting blackish spots, second and third segments bearing marginal macrochætæ, wanting on the first; front pulvilli two-thirds as long as the last tarsal joint; wings hyaline, third vein bearing five bristles at

[1] The identity of *ruficauda* and *obsoleta* has already been given by F. H. Snow in the Kansas University Quarterly, Vol. III, p. 183, from an examination of the type specimens.

[2] In the Zweif. Kais. Mus. Wien, VI, p. 222, Brauer and Bergenstamm state that Fallen's type specimen of *hebes* is identical with their *bisetosa*.

the base; calypteres white; length, 12 mm. Alameda County, Cal. A single male specimen reared from an undetermined lepidopterous chrysalis by Mr. Albert Koebele in September. Type No. 3641, U. S. National Museum ..... *antennalis* n. sp.

Unrecognized species.—*S.* (*Cnephalia*) *finitima* Snow. Kansas University Quarterly, Vol. III, p. 184; 1895. N. Mex.

Genus GÆDIOPSIS Br. and Berg.

Gædiopsis Brauer and Bergenstamm, Zweif. Kais. Mus. Wien, V, p. 336; 1891.

Our species have four postsutural and four sternopleural macrochætæ:

1. Fourth segment of abdomen black ..... 2.

   Fourth segment yellow, second and third segments destitute of discal macrochætæ, legs black, macrochætæ on sides of face very small, hardly two-thirds as long as those on the facial ridges; length, 11 mm. Philadelphia, Pa. (Zweif. Kais. Mus. Wien, VI, p. 190; 1893.) ..... *mexicana* Br. and Berg.

2. Second and third segments of abdomen bearing only marginal macrochætæ, femora and tibiæ yellow; length, 7.5 mm. Tifton, Ga., and Mobile, Ala. (Journal N. Y. Ent. Soc., Vol. III, p. 100; September, 1895.) ..... *flavipes* Coq.

   Second and third segments bearing discal and marginal macrochætæ, legs black; black, the face, cheeks, palpi, scutellum, and sometimes the second antennal joint and a spot on sides of each of the first three segments of the abdomen, yellow; front of male four fifths, of female one and one-fifth times, as wide as either eye, two pairs of orbital bristles in the female, none in the male, sides of face bearing a row of macrochætæ as long as those on the facial ridges, and in addition numerous bristly hairs, principally located near the eyes; cheeks over one-third as broad as the eye-height; antennæ five sixths as long as the face, the third joint in the male two and one-half times, in the female twice, as long as the second, arista thickened on the basal two-thirds, the penultimate joint four or five times as long as wide; facial ridges bristly on the lower three-fifths; thorax gray pollinose, marked with four black vittæ, scutellum bearing three pairs of long marginal and a short apical pair of macrochætæ; abdomen gray pollinose and with dark reflecting spots; middle tibiæ each bearing three macrochætæ on the front side near the middle, hind tibiæ outwardly ciliate, front pulvilli of male as long as the last tarsal joint; wings hyaline, third vein bearing two bristles near the base, bend of fourth vein not appendiculate, calypteres white; length, 12 mm. Siskiyou Co., Cal. A male and a female bred by A. Koebele from chrysalids of an unknown Noctuid. Type No. 3642, U. S. Nat. Mus. . *setosa* n. sp.

Genus CHÆTOGÆDIA Br. and Berg.

Chætogædia Brauer and Bergenstamm, Zweif. Kais. Mus. Wien, V, p. 336; 1891.

Our species have four postsutural and four sternopleural macrochætæ; palpi yellow:

1. Femora black, apical cell open ..... 2.
   Femora and tibiæ yellow, apical cell short petiolate, hind tibiæ outwardly ciliate, sides of front densely yellowish gray pollinose, sides of face each bearing a row of macrochætæ and with a row of bristly hairs between it and the eye; length, 8 mm. Santa Fe, N. Mex. (Biol. Cent.-Amer., Diptera, Vol. II, p. 121; May, 1890: *Prospherysa.*) ..... *rufifrons* v. d. W.
2. Sides of front opaque, covered with a grayish pollen ..... 3.
   Sides of front shining, destitute of pollen, sides of face bearing two or more irregular rows of bristly hairs between each eye and the row of macrochætæ, abdomen black, the fourth segment yellow; length, 10 to 12 mm. District of Columbia, and Mescalero, N. Mex. (Tijdschr. voor Ent., Vol. II, p. 148; 1867: *Baumhaueria. Frontina acroglossoides* Townsend. Trans. Amer. Ent. Soc., Vol. XVIII, p. 367; December, 1891.) ..... *analis* v. d. W.
3. Macrochætæ on sides of face much nearer to the eyes than to the facial ridges and appearing like a continuation of the frontal bristles, only a few bristly hairs between them and the eyes; abdomen wholly black; length, 10 to 12 mm. Las Cruces, N. Mex., and California. (Biol. Cent.-Amer., Diptera, vol. II, p. 120; May, 1890: *Prospherysa.*) ..... *crebra* v. d. W.
   Macrochætæ on sides of face nearer to the facial ridges than to the eyes and widely removed from the lowest frontal bristles, numerous bristly hairs between them and the eyes, sides of abdomen and the fourth segment largely or wholly yellowish; length, 10 to 12 mm. California, and Kailua, Hawaii. (Ann. Soc. Ent. France, p. 91; 1888: *Blepharipeza.*) ..... *monticola* Bigot.

Genus DICHOCERA Will.

Dichocera Williston, Entomological News, Vol. VI, p. 31; January, 1895.

Our two species are black, the palpi, apex of scutellum and of the abdomen, and in one species also the antennæ, yellow; two sternopleural macrochætæ:

Third antennal joint yellow, three postsutural macrochætæ, a marginal pair on the second abdominal segment and a discal pair on the third; length, 10 mm. Eastern Washington. (Entomological News, Vol. VI, p. 32; January, 1895.) ..... *lyrata* Will.

Third antennal joint largely black, four postsutural macrochætæ, second abdominal segment destitute of a marginal pair, the third destitute of a discal pair; black, the first two joints of antennæ

and lower side of the third at its base, the palpi, apex of scutellum and of the abdomen, yellow: front in female one and one-fifth times as wide as either eye, two pairs of orbital bristles, sides of face bristly on the upper two-thirds in addition to the row of macrochætæ, cheeks slightly wider than the eye height, antennæ four-fifths as long as the face, the third joint four times as long as the second; arista thickened on the basal three-fifths, the penultimate joint four times as long as wide, nearly twice as long as the first joint; thorax gray pollinose, marked with four black vittæ; scutellum bearing three pairs of long marginal macrochætæ; abdomen destitute of dorsal macrochætæ on the first two segments, the third with a marginal row, the fourth covered except on the basal half; middle tibiæ each bearing three long macrochætæ on the outside near its middle, front tarsi slightly dilated; wings hyaline, apical cell nearly as wide as the discal cell, third vein bristly nearly halfway to the small crossvein, the others bare, bend of fourth vein not appendiculate, calypteres white; length, 11 mm. Beverly, Mass. Two female specimens. Type No. 3643, U. S. National Museum..... *orientalis* n. sp.

Genus MICROPHTHALMA Macq.

Microphthalma Macquart, Diptères Exotiques, Vol. II, Part III, p. 241 (81); 1843.

Our species is black, the antennæ, face, cheeks, palpi and apex of proboscis, yellow; three postsutural and three sternopleural macrochætæ; length, 12 to 15 mm. Franconia, N. H.; Beverly, Mass.; District of Columbia; Chicago, Ill.; Georgia; Utica, Miss.; Texas; Onaga, Kans., and Kern County, Cal. (Analecta Entomologica, p. 45; 1824: *Tachina. Miltogramma trifasciata* Say, Jour. Acad. Nat. Sciences Phila., Vol. VI, p. 174; 1829. *Microphthalma nigra* Macquart, Diptères Exotiques, Vol. II, Part III, p. 242 (85); 1843. *Tachina trixoides* Walker, List of Dipt. Insects, Part IV, p. 760; 1849. *Megaprosopus michiganensis* Townsend, Trans. Amer. Ent. Soc., Vol. XIX, p. 111; May, 1892. *Macronychia trifasciata* Say, Brauer and Bergenstamm *in litt.* *Dexiosoma* sp., Brauer and Bergenstamm *in litt.*) .. *disjuncta* Wied.

Genus AMOBIA Desv.

Amobia Desvoidy, Essai sur les Myodaires, p. 96; 1830.
Macronychia Rondani, Dipterologiæ Italicæ Prodromus, p. 229; 1859.
Trixoclista Townsend, Trans. Amer. Ent. Soc., Vol. XIX, p. 102; 1892.
Ammobia Brauer and Bergenstamm, Zweiflügler Kais. Mus. Wien, VI, p. 226; 1893. (*Non* Billberg, Enumeratio Insectorum, p. 105; 1820.)

The synonymy of Amobia and Macronychia has already been given by Schiner,[1] and repeated by Brauer and Bergenstamm.[2] Two species occur in our fauna; both have only three postsutural macrochætæ:

Thorax marked with three or five black vittæ; abdomen gray pollinose, marked with three rows of black spots; orbital bristles

[1] Fauna Austrica, Vol. I, p. 501; 1862.
[2] Zweif. Kais. Mus. Wien, VI, p. 226; 1893.

present in both sexes; length, 7 to 9 mm. London, Canada; White Mountains, New Hampshire; Colorado, and Washington. (Trans. Amer. Ent. Soc., Vol. XIX, p. 103; May 1892: *Trixoclista.*) ..... *distincta* Town.

Thorax marked with four black vittæ; abdomen shining black, bases of the segments thinly gray pollinose; length, 9 to 11 mm. Los Angeles County, Cal. (Journ. N. Y. Ent. Soc., Vol. III, p. 100; September. 1895.) ..... *californica* Coq.

Genus TRICHOPHORA Macq.

Trichophora Macquart, Diptères Exotiques, Supplement II, p. 78 (62); 1847.
Elachipalpus Rondani, Nuovi Ann. Sc. Nat. Bologna, Vol. II, p. 169; 1850.

Brauer and Bergenstamm state that these two genera could properly be united into one genus,[1] and the writer is of the same opinion. Our species have three postsutural and three sternopleural macrochætæ, the second and third segments of the abdomen bearing only marginal ones, apex of the fourth segment yellowish, the third vein bristly almost to the small crossvein:

Ocellar bristles absent, scutellum wholly black; length, 8 to 10 mm. Montgomery County, Pa.; Dist. Columbia; Virginia; Georgia; Lake Worth, Fla.; Utica, Miss., and Texas. (Tijdschrift voor Entom., Vol. II, p. 146; 1867: *Schineria. Elachipalpus undulatus* Say MS., Brauer and Bergenstamm *in litt.*) ..*ruficauda* v. d. W.

Ocellar bristles present, directed obliquely forward; black, the first two joints of the antennæ, face, cheeks, apex of scutellum, and of the fourth segment of the abdomen, also the tibiæ, yellow, frontal vitta and third joint of antennæ, brown; front of female one and one-half times as wide as either eye, the sides subopaque gray pollinose and bearing two pairs of orbital bristles, sides of face bearing sparse and rather short black hairs, cheeks one-half as broad as the eye height, head at the vibrissæ as long as at base of antennæ, antennæ four-fifths as long as the face, the third joint as long as the second, scarcely longer than broad, arista thickened on the basal two-thirds, the penultimate joint three times as long as broad; thorax gray pollinose, marked with four black vittæ, scutellum bearing two long marginal pairs and a short apical pair of macrochætæ; abdomen gray pollinose and with darker reflecting spots, second and third segments bearing marginal, the fourth with discal and marginal macrochætæ; wings hyaline, the base tinged with yellowish, calypteres white; length, 9 mm. Los Angeles County, Cal. A single female specimen bred from a chrysalis of *Adisophanes miscellus* by A. Koebele. Type No. 3645, U. S. National Museum ..... *miscelli* n. sp.

[1] Zweif. Kais. Mus. Wien, VI, p. 214; 1893.

Genus CUPHOCERA Macq.

Cuphocera Macquart, Annales Soc. Ent. France, p. 267; 1845.
Palpibraca Rondani, Annali Naturalisti Napoli; 1845.
Sphyricera Lioy, Atti Instituto Veneto, Vol. IX, p. 1336; 1864.

The synonymy of the first two is according to Rondani.[1] Sphyricera is referred by Brauer and Bergenstamm as a subgenus of Cuphocera.[2] Our two species have three postsutural and three sternopleural macrochætæ:

Abdomen black, the fourth segment yellowish; length, 10 to 12 mm. Franconia, N. H.; Massachusetts; Westville, N. J., and northern Illinois. (Tijdschrift voor Entomologie, Vol. XXXV, p. 193; 1892: *Trichophora.*) ..... *fucata* v. d. W.

Abdomen yellowish, a dorsal black vitta on the first three segments; length, 10 to 13 mm. Lake Worth, Fla., and California. (Diptères Exotiques, Supplement IV, part II, p. 148 (175); 1849: *Micropalpus.*) ..... *californiensis* Macq.

Genus PELETERIA Desv.

Peleteria Desvoidy, Essai sur les Myodaires, p. 39; 1830.
Sphyromyia Bigot, Bulletin Soc. Ent. France, p. 108; 1883.
Chætopeleteria Mik, Wiener Entomol. Zeitung, Vol. XIII, p. 100; March 31, 1894.
Tetrachæta Brauer and Bergenstamm, Zweif. Kais. Mus. Wien, VII, p. 611; 1894.

The synonymy of the first two is by the writer; the last two are given by Brauer and Bergenstamm as subgenera of Peleteria.[3] Our species have four postsutural and three sternopleural macrochætæ:

1. Abdomen yellow on the sides or at the apex, thorax and sides of front pollinose ..... 2.

   Abdomen wholly shining black, not pollinose, sides of front shining bronze black, thorax shining, almost destitute of pollen, front tarsi of female noticeably dilated; length, 12.5 mm. Bighorn Mountains, Wyoming; Colorado, and Salmon City, Idaho. (In Zetterstedt's Diptera Scandinaviæ, Vol. VIII, p. 3217; 1849: *Echinomyia. ? Tachina hirta* Curtis, in Ross's Voyage to the Arctic Region, p. 79; 1831.) ..... *ænea* Staeger.

2. Second and third segments of abdomen largely or wholly gray pollinose; length, 10 to 14 mm. Toronto, Canada; White Mountains, New Hampshire; Allegheny, Pa.; Ithaca, N. Y.; northern Illinois; Missouri; Georgia; Texas; Denver, Colo., and Santa Cruz, Lake, Calaveras and Los Angeles counties, Cal. (Aussereuropäische Zweif. Insekten, Vol. II, p. 290; 1830: *Tachina. Echinomyia analis* Macquart, Diptères Exotiques, Suppl. I, p. 144; 1846. *Tachina anaxias* Walker, List of Dipterous Insects, Part IV, p. 726; 1849. *Echinomyia filipalpis* Rondani, Archivio Zool. l'Anat. e Fisiologia, Vol. III, p. 15; 1865. *Echinomyia*

[1] Dipterologiæ Italicæ Prodromus, Vol. I, p. 63; 1856.
[2] Zweif. Kais. Mus. Wien, VII, p. 613; 1894.
[3] Zweif. Kais. Mus. Wien, VII, p. 613; 1894

hæmorrhoa van der Wulp, Tijdschrift voor Entomologie, Vol. II, p. 145; 1867. *Echinomyia filipalpis* Thomson, Kongliga Svenska Fregatten Eugenies Resa, Diptera, p. 517; 1868. *Sphyromyia malleola* Bigot, Bulletin Soc. Entomol. France, p. 109; 1883. *Echinomyia thomsoni*[1] Williston, Trans. Amer. Ent. Soc., Vol. XIII, p. 301; October, 1886. *Echinomyia cora* Bigot, Annales Soc. Entomol. France, p. cxl; 1887. *Echinomyia cinerascens* Bigot, loc. cit., p. 256; 1888. *Peleteria thomsoni* Will., Brauer and Bergenstamm *in litt.*) ..... *robusta* Wied.

Second and third segments destitute of pollen on the yellow lateral portions except at the extreme bases; abdomen light yellow, usually marked with a dorsal row of black spots; length, 9 to 14 mm. Georgetown, Canada; White Mountains, New Hampshire; Beverly, Mass.; Lansing, Mich.; northern Illinois; Canon City, Colo.; Pullman, Wash.; Germany, and Austria. Two males from Austria received from Brauer and Bergenstamm, and by them labeled *Peleteria tessellata* Meig.; also one female from Germany, received from V. von Roeder, and by him labeled *Echinomyia tessellata*. (Entomologia Systematica, Vol. IV, p. 324; 1796: *Musca*. *Echinomyia nigricornis* Desvoidy, Essai sur les Myodaires, p. 45; 1830. *Tachina punctifera* Walker, List of Dipterous Insects, Part IV, p. 728; 1849. *Echinomyia faviventris* van der Wulp, Biol. Cent.-Amer., Diptera, Vol. II, p. 32; April, 1888. *Echinomyia neglecta* Townsend, Annals Mag. Nat. Hist., Vol. XIX, p. 148; Feb., 1897. *Peleteria robusta* Wied., Brauer and Bergenstamm *in litt.*) ..... *tessellata* Fabr.

Genus ARCHYTAS Jaen.

Archytas Jaennicke, Neue Exotische Diptereu, p. 392; 1867.
Nemochæta van der Wulp, Biol. Cent.-Americana, Dipt., Vol. II, p. 38; April, 1888.
Tachinodes Brauer and Bergenstamm, Zweif. Kais. Mus. Wien, IV, p. 133; 1889.
Parafabricia Brauer and Bergenstamm, loc. cit., VII, p. 612; 1894.

The above synonymy except the last one is according to Brauer and Bergenstamm,[2] who compared the types of these three descriptions; these authors state that the type of the genus Archytas has the proboscis broken, which accounts for the peculiar form accorded to this organ by Jaennicke. Parafabricia was considered by its founders as

[1] This name was proposed by Dr. Williston to replace *filipalpis* Thoms., preoccupied. On page 301 he gives *anaxias* Walk. and *analis* Macq. as probable synonyms of *hæmorrhoa* v. d. W. In the Biol. Cent.-Amer., Diptera, Vol. II, p. 32, van der Wulp gives the latter as synonymous with *robusta* Wied., places *analis* Macq. and *filipalpis* Rond. in the same category, and states that *filipalpis* Thom. may also be added to this list. He doubts the correctness of Williston's reference of *anaxias* Walk., owing to Walker's statement that there are "no bristles on the sides of the face;" but Walker refers to the facial ridges, and not to the sides of the face as at present understood. In the Dipteri del Messico, p. 10, Giglio-Tos places *cora* Bigot as a synonym of *filipalpis* Rond.

[2] Zweif. Kais. Mus. Wien, VI, p. 146; 1893.

being a subgenus of Archytas.[1] All of our species have the third antennal joint strongly convex on the upper side, four postsutural and three sternopleural macrochætæ:

1. Sides of face bearing black hairs, abdomen shining, not pollinose.. 3.
   Sides of face destitute of black hairs; calypteres whitish..... 2.
2. Abdomen subopaque, marked with large gray pollinose spots; black, the head except the occiput, the first two joints of antennæ, palpi, fourth abdominal segment largely, and sometimes the sides of the second, yellowish; thorax subopaque gray pollinose, marked with four black vittæ; length, 10 mm. Waco, Tex., and Jamaica, West Indies. (Tijdschrift voor Entomologie, Vol. XXVI, p. 22; 1883: *Echinomyia.*).....*piliventris* v. d. W.

   Abdomen shining, tinged with blue, not pollinose except the fourth segment; thorax opaque gray pollinose, with a strong brassy tinge, marked with five black vittæ, scutellum yellow, sometimes the sides and tip of the abdomen are more or less yellow; length, 11 to 15 mm. Toronto, Canada; White Mountains, New Hampshire; New York, N. Y.; District of Columbia; northern Illinois; Missouri; Georgia; Waco, Tex.; northern California, and Jamaica, West Indies. (Systema Antliatorum, p. 311; 1805: *Tachina. Jurinia amethystina* Macquart, Diptères Exotiques, Vol. II, Part II, p. 199 [42], 1842; and Supplement I, p. 147. *Tachina apicifera* Walker, List of Dipterous Insects, Part IV, p. 718; 1849. *Tachina californiæ* Walker, Insecta Saundersiana, Vol. I, p. 270; 1856. *Archytas* sp., Brauer and Bergenstamm *in litt.*).....*analis* Fabr.
3. Calypteres whitish..... 4.
   Calypteres brown, thorax shining bluish, the front end grayish pollinose and marked with four black vittæ, abdomen shining reddish, strongly tinged with pale blue; length, 13 to 16 mm. New Bedford, Mass.; Cumberland Gap, Ky.; Florida; Egypt, Ga.; Holly Springs, Miss.; Baton Rouge, La., and Kansas. (Systema Entomologiæ, p. 777; 1775: *Musca. Jurinia boscii* Desvoidy, Essai sur les Myodaires, p. 36; 1830. *Echinomyia georgica* Macquart, Histoire Naturelle Insectes, Diptères, Vol. II, p. 79; 1835. *Jurinia virginiensis* Macquart, Diptères Exotiques, Supplement IV, Part II, p. 144 (171); 1851. *Jurinia fuscipennis* Jaennicke, Neue Exot. Dipt., p. 83 (391); 1867. *Jurinia hystricoides* Williston, Trans. Am. Ent. Soc., Vol. XIII, p. 300; October, 1886. *Archytas hystricoides* Will., Brauer and Bergenstamm *in litt.*).....*hystrix*[2] Fabr.

[1] Loc. cit., VII, p. 613.

[2] In the Zweif. Kais. Mus. Wien, IV, p. 133, Brauer and Bergenstamm refer this species to the present genus from an examination of specimens which Wiedemann compared with the type specimen of *hystrix* and declared them to be identical with the latter.

4. Thorax bluish, subshining, thinly gray pollinose, and marked with four black vittæ; abdomen blackish, strongly tinged with blue, first joint of arista scarcely longer than wide; length, 10 to 15 mm. White Mountains, New Hampshire; Beverly, Mass.; New York, N. Y.; District of Columbia; Virginia; North Carolina; Florida; Tifton, Ga.; Holly Springs, Miss.; Cadet, Mo., and Keokuk, Iowa. (Essai sur les Myodaires, p. 35; 1830; *Jurinia. Jurinia leucostoma* Desvoidy, loc. cit., p. 37. *Jurinia smaragdina* Macquart, Diptères Exotiques, Vol. II, Part III, p. 196; 1842. *Tachina atra* Walker, Insecta Saundersiana, Vol. I, p. 273; 1856. *Archytas aterrima* Desv., Brauer and Bergenstamm *in litt.*)
aterrima Desv.

Thorax with a bronze tinge, subopaque, gray pollinose and marked with four black vittæ; abdomen black, with a bluish tinge, the sides broadly reddish, first joint of arista usually twice as long as wide; length, 11 to 15 mm. Massachusetts, North Carolina, Georgia, Florida, and Colorado. (Diptères Exotiques, Vol. II, Part II, p. 199 [42]; 1842. *Tachina candens* Walker, List of Dipterous Insects, Part IV, p. 720; 1849. *Tachina iterans* Walker, l. c., p. 727. *Jurinia apicalis* Jaennicke, Neue Exot. Dipt., p. 82 [390]; 1867. *Echinomyia victoria* Townsend, Annals Mag. Nat. Hist., Vol. XIX, p. 148; February, 1897.).....*lateralis* Macq.

Genus ECHINOMYIA Dumeril.

Echinomyia Dumeril, Exposit. Methode Naturelle Class. Insectes; 1801.
Fabricia Desvoidy, Essai sur les Myodaires, p. 42; 1830. (*Non* Blainville, 1828.)
Mikia Kowarz, Wiener Ent. Zeitung, Vol. IV, p. 51; February 1, 1885.
Pareudora Wachtl, Wiener Ent. Zeitung, Vol. XIII, p. 140; April 20, 1894.
Nowickia Wachtl, loc. cit.
Pararchytas Brauer and Bergenstamm, Zweif. Kais. Mus. Wien, VII, p. 614; 1894.

The two genera of Wachtl are stated by Brauer and Bergenstamm to be identical with Echinomyia, and they place Fabricia, Mikia, and Pararchytas as subgenera of it.[1] Our species have four postsutural and usually three sternopleural macrochætæ:

1. Small crossvein never clouded with brown..... 2.
Small crossvein distinctly clouded, sides of mesonotum, scutellum, and abdomen, except sometimes a dorsal vitta, yellowish red; base of wings brown; length, 11 to 13 mm. Toronto, Canada; White Mountains, N. H.; New Jersey; Colorado, and southern California. (List of Dipterous Insects, Part IV, p. 715; 1849: *Tachina. Jurinia echinata* Thompson, Kongliga Svenska Fregatten Eugenies Resa, Diptera, p. 516; 1868. *Tachinodes decisa* Walk., Brauer and Bergenstamm *in litt.*).....*decisa* Walk.

[1] Zweif. Kais. Mus. Wien, VII, p. 614; 1894.

2. Abdomen distinctly yellowish on the sides or at the apex..... 3.
Abdomen and thorax wholly blackish, sides of the former sometimes tinged with reddish; base of wings yellow; length, 12 to 17 mm. Toronto, Canada; White Mountains and Franconia, N. H.; Vermont; New Bedford, Mass.; Oswego, N. Y.; Colorado; Montana; British Columbia; Washington; Oregon, and California. (Ausser. Zweif. Insekten, Vol. II, p. 285; 1830: *Tachina*. *Echinomyia picea* Desvoidy, Essai sur les Myodaires, p. 44; 1830. *Echinomyia lapilai* Desvoidy, loc. cit. *Tachina degenera* Walker, List of Dipterous Insects, Part IV, p. 732; 1849. *Jurinia nitida* van der Wulp, Notes from the Leyden Museum, Vol. IV, p. 82; 1882. *Echinomyia lugubris* van der Wulp, Tijdschrift voor Entomologie, Vol. XXVI, p. 20; 1883.)
algens Wied.

3. Second segment of abdomen bearing at most four marginal macrochætæ ..... 4.
Second segment of abdomen bearing at least ten marginal macrochætæ on the dorsum, abdomen wholly yellow, middle of dorsum of second and third segments covered with black macrochætæ; length, 14 mm. Colorado and Washington. (Trans. Amer. Ent. Soc., Vol. XIII, p. 297; October, 1886: *Dejeania*.) *hystricosa* Will.

4. First segment of abdomen on the sides largely or wholly yellow, the fourth yellow at least on the front corners..... 5.
First segment wholly black, or at most with the hind angles narrowly yellow; front tarsi of female broadly dilated; abdomen black, the apex broadly, or the sides of the last three segments and apex of the last, or only the sides of the second and third segments, yellow; length, 10 to 13 mm. Canada; White Mountains and Franconia, N. H.; New Bedford, Mass.; Buena Vista, N. J., and North Carolina. (List of Dipterous Insects, Part IV, p. 722; 1849: *Tachina*.) ..... *florum* Walk.

5. Palpi only half as long as the proboscis beyond the basal articulation, front of male one and one half times as wide as either eye, head at base of antennæ much longer than at the vibrissæ, front projecting in front of the eyes one and one-half times the horizontal diameter of the latter; abdomen of male yellow, middle of first segment, a dorsal spot, and genitalia black; length, 12 mm. Los Angeles County, Cal. (Bulletin Soc. Ent. France, p. cxli; 1887: *Fabricia*.) ..... *infumata* Bigot.
Palpi almost as long as the proboscis, front of male two-thirds as wide as either eye, head at base of antennæ not longer than at the vibrissæ, front projecting in front of the eyes less than the horizontal diameter of the latter; abdomen yellow, usually marked with a black dorsal vitta or row of spots; length, 10 to 14 mm. Franconia, N. H.; North Carolina; Colo., and California. (Trans. Amer. Ent. Soc., Vol. XIX, p. 94; April, 1892. *Tachina* sp., Brauer and Bergenstamm *in litt.*) *dakotensis* Town.

Genus EPALPUS Rond.

Epalpus Rondani, Nuovi Annali Sci. Nat. Bologna, Vol. II, p. 170 (6); 1850.

Our species have three sternopleural macrochætæ:

1. With four postsutural macrochætæ, hairs on sides of face black, femora largely or wholly black ..... 2.

   With only three postsutural macrochætæ; hairs on sides of face and the femora, tibiæ, and entire abdomen yellow; second and third segments of abdomen bearing discal and marginal macrochætæ; length, 9 to 11 mm. Colorado. (Biologia Cent.-Amer., Diptera, Vol. II, p. 23; April, 1888: *Saundersia*. *Epalpus* sp., Brauer and Bergenstamm *in litt.*) ..... *nigripilosa* v. d. W.

2. Abdomen shining, destitute of pollen, yellow, the fourth segment black; second segment bearing a discal cluster and a marginal row of about twelve macrochætæ; length, 10 to 13 mm. Summit County, Colo., and Siskiyou County, Cal. (Trans. Amer. Ent. Soc., Vol. XIII, p. 304; October, 1886: *Saundersia*. *Epalpus bicolor* Will., Brauer and Bergenstamm *in litt.*) ..... *bicolor* Will.

   Abdomen black, the sides sometimes partly reddish, fourth segment marked with a large spot of gray pollen, sometimes a dorsal vitta of gray pollen on the third, second segment bearing a discal cluster of from four to twelve and a marginal pair of macrochætæ; length, 10 to 11 mm. Franconia, N. H.; Beverly and Hyde Park, Mass.; Maryland; North Carolina; Custer County, Colo.; Tenino, Wash., and California. (List of Dipterous Insects, Part IV, p. 708; 1849: *Tachina*. *Epalpus signifera* (Walk.) O. S., Brauer and Bergenstamm *in litt.*) ..... *signifera*[1] Walk.

Unrecognized species.—*E.* (*Saundersia*) *maculata* Williston, Trans. Amer. Ent. Soc., Vol. XIII, p. 304; November, 1886. N. Mex.

Genus BOMBYLIOMYIA Br. and Berg.

Bombyliomyia Brauer and Bergenstamm, Zweif. Kais. Mus. Wien, IV, p. 131; 1889.

Our single species is yellow, the sides of the front, third joint of antennæ, arista, dorsum of thorax except the lateral margins, and a dorsal row of small spots on the abdomen, black; two postsutural and two sternopleural macrochætæ; length, 11 to 14 mm. Toronto, Canada; White Mountains, New Hampshire; Beverly, Mass.; Trenton, N. J.; Allegheny, Pa.; Utica, Lake George, and New York, N. Y.; Ohio; Colorado, and Washington. (Ausser. Zweif. Insekten, Vol. II, p. 293;

[1] In the Trans. Amer. Ent. Soc., Vol. XIII, p. 303, Dr. Williston doubtfully refers this species to the genus Saundersia, but in the Biol. Cent.-Amer., Diptera, Vol. II, p. 22, van der Wulp states that this reference is very doubtful, since Walker mentions the palpi in his description. This is the only species, however, from the eastern part of North America that at all agrees with Walker's description, and the fact that he mistook the folds in the mouth for palpi will not at all surprise any student familiar with the doings of that author.

1830: *Tachina*. *Tachina vivida* Harris, Rept. Insects Mass. Injurious to Vegetation, p. 612; 1841. *Hystricia testacea* Macquart, Diptères Exotiques, Vol. II, Part III, p. 201 [44]; 1842. *Tachina finitima* Walker, List of Dipterous Insects, Part IV, p. 707; 1849. *Hystricia fulvida* Bigot, Bulletin Soc. Ent. France, p. cvi; 1888. *Bombyliomyia abrupta* Wied., Brauer and Bergenstamm *in litt.*) ..... *abrupta* Wied.

Genus DEJEANIA Desv.

Dejeania Desvoidy, Essai sur les Myodaires, p. 33; 1830.

Our single species is yellow, the third joint of antennæ, arista, proboscis, dorsum of thorax, portions of the pleura and usually a dorsal row of spots on the abdomen, black; four postsutural and two sternopleural macrochætæ; front tarsi of male not ciliate on the side with short bristles, those of the female slightly dilated on the last four joints; length, 13 to 15 mm. Colorado. (Western Diptera, p. 343; April 30, 1877. *Dejeania* sp. *non corpulenta* Wied.,[1] Brauer and Bergenstamm *in litt.*) ..... *vexatrix* O. S.

Genus PARADEJEANIA Br. and Berg.

Paradejeania Brauer and Bergenstamm, Zweif. Kais. Mus. Wien, VI, p. 147; 1893.

Our single species is yellow, the front, antennæ, proboscis, occiput, thorax except the hind margin, legs, and sometimes a dorsal vitta or row of spots and the fourth segment of the abdomen, black; wings smoky gray, calypteres yellow; four postsutural and three sternopleural macrochætæ; length, 16 to 18 mm. Manitou and Colorado Springs, Colo., and Santa Cruz and San Diego counties, Cal. (Neue Exot. Dipteren, p. 86 (137); 1867: *Dejeania*. *Jurinia rutilioides* Jaen., Brauer and Bergenstamm *in litt.*) ..... *rutilioides* Jaen.

Genus JURINIA Desv.

Jurinia Desvoidy, Essai sur les Myodaires, p. 34; 1830.

Our single species has the thorax blue-black, lightly gray pollinose on the front half, four postsutural and three sternopleural macrochætæ; scutellum and abdomen reddish, and having a slight violaceous reflection, calypteres and bases of the wings brown; length, 13 to 18 mm. West Virginia; Cumberland Gap, Ky.; Georgia; Georgiana and Lake

[1]Osten Sacken states, on page 256 of his well known Catalogue of North American Diptera, that after examining the type of *Tachina corpulenta* Wied. from Mexico he reached the conclusion that it belongs to the same species as his *Dejeania vexatrix*. In this, however, he was evidently in error, since Schiner, who also had access to Wiedemann's type of *corpulenta*, states in the Reise der Novara, Part Diptera, page 337, that in this species the front tarsi of the male have long bristly hairs on the inner side, which is not at all the case with *vexatrix*. Moreover, Brauer and Bergenstamm have compared our specimens of *vexatrix* with Wiedemann's type of *corpulenta*, and pronounce them specifically distinct.

Worth, Fla.; Texas, and Colorado. (Essai sur les Myodaires, p. 35; 1830. *Jurinia adusta* van der Wulp, Biologia Cent.-Amer., Diptera, Vol. II, p. 28; April, 1888. *Jurinia hystrix* Will. *non* Fabr., Brauer and Bergenstamm *in litt.*) ..... *metallica* Desv.

Genus JURINELLA, Br. and Berg.

Jurinella Brauer and Bergenstamm, Zweif. Kais. Mus. Wien, IV, p. 132; 1889.
Pseudohystricia Brauer and Bergenstamm, loc. cit.

This synonymy is original with the writer. Our species have four postsutural and three sternopleural macrochætæ:

Thorax densely yellowish pollinose, the hairs and those of the face and cheeks pale yellowish; abdomen strongly tinged with blue; length, 14 to 17 mm. Colorado. (Diptères Exotiques, Supplement IV, p. 145 [172]; 1849: *Hystricia. Pseudohystricia ambigua* Macq., Brauer and Bergenstamm *in litt.*) ..... *ambigua* Macq.

Thorax lightly bluish gray pollinose, the hairs and those of the face and cheeks black; abdomen not tinged with blue; length, 11 mm. Colorado. (Trans. Amer. Ent. Soc., Vol. XIII, p. 298; October, 1886: *Hystricia.*) ..... *soror* Will.

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U. S. DEPARTMENT OF AGRICULTURE,

DIVISION OF ENTOMOLOGY.

CORRECTED INDEX TO BULLETIN No. 7, TECHNICAL SERIES.

Owing to imperfections and omissions in the index which is bound in with this bulletin an entirely new index has been prepared, and correspondents and others who receive the bulletin are requested to replace the old index with the corrected one, a copy of which is inclosed with this.

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* *Tachina orygiæ* LeBaron, First Rept. Ins. Ill., p. 16, 1871, is omitted in Osten Sacken's Catalogue, and in the preceding pages. It is a synonym of *Tachina mella* Walk.

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ERRATA.

Page 10, line 15 from below, place a star (*) before Leucarctia.
Page 23, lines 2 to 4, transfer the * to Ocyptera and erase Trichopoda plumipes *Fabr.*
Page 23, line 11 from below, erase "Phorichæta sequax Will."
Page 25, line 4, erase the * before Belvosia.
Page 26, line 13, for "Phorocera parva *Bigot*" read Phorocera leucaniæ *Coq.*
Page 36, couplet 98, for "Base" read Bend.
Page 88, line 10 from below, erase "Vol. VI."
Page 103, line 4, erase "Vol. VIII."
Page 110, line 9 from below, for "3" read 2.
Page 114, line 23, for "*tenthredinidarum* Town." read *exilis* n. sp. The former belongs to Frontina.
Page 119, line 11 from below, after "Ital." add Prodromus.
Page 126, line 14 from below, "From the type specimen" refers to *Metachæta atra.*

TECHNICAL SERIES No. 8.

U. S. DEPARTMENT OF AGRICULTURE.

DIVISION OF ENTOMOLOGY.

CONTRIBUTIONS TOWARD A MONOGRAPH OF THE AMERICAN ALEURODIDÆ.

BY

A. L. QUAINTANCE, M. S.,

Biologist and Horticulturist of the Georgia Agricultural Experiment Station, Experiment, Ga.

THE RED SPIDERS OF THE UNITED STATES

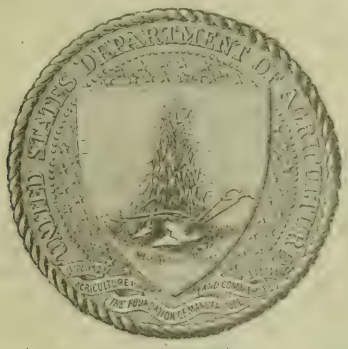
(TETRANYCHUS AND STIGMÆUS).

BY

NATHAN BANKS, M. S.,

Assistant, Division of Entomology, U. S. Department of Agriculture.

PREPARED UNDER THE DIRECTION OF THE ENTOMOLOGIST.



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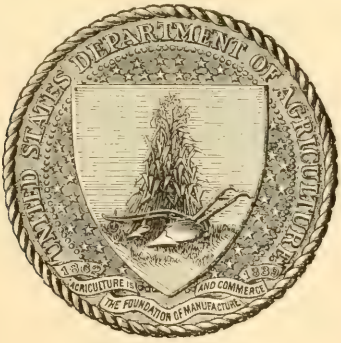

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LETTER OF TRANSMITTAL.

UNITED STATES DEPARTMENT OF AGRICULTURE,
DIVISION OF ENTOMOLOGY,
Washington, D. C., April 10, 1900.

SIR: I have the honor to submit for publication No. 8 of the technical series of bulletins of this Division. It contains two articles, the one prepared by Mr. A. L. Quaintance, biologist and horticulturist, Georgia Agricultural Experiment Station, and the other, at the writer's suggestion, by Mr. Nathan Banks, of this Division. The subjects considered, namely, the so-called white flies (Family Aleurodidæ) and the so-called red spiders (the Acarid genera Tetranychus and Stigmæus), are both groups of very considerable economic importance, some of the white flies doing considerable damage to Southern horticulture, and the red spiders being known as greenhouse pests in all parts of the country and as outdoor enemies to certain crops in the warmer States. With these groups, as with the others which have been previously treated in a monographic way in the earlier bulletins of this series, there has existed, up to the present time, so much confusion as to the differentiation of forms that the economic worker has not been able to know with any certainty the exact form upon which he might happen to be at work from the remedial standpoint. It is hoped that these papers will clear the field so that this uncertainty need no longer exist.

Respectfully,

L. O. HOWARD,
Entomologist.

Hon. JAMES WILSON,
Secretary of Agriculture.

Smithsonian Institution
JUL 31 1900

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CONTRIBUTIONS TOWARD A MONOGRAPH OF THE AMERICAN ALEURODIDÆ.

By A. L. Quaintance.

INTRODUCTION.

The writer's attention was called to this much neglected family of Homopterous insects about four years ago by Prof. T. D. A. Cockerell, since which time considerable material has been collected, or sent in by correspondents, and during the past year I have had the pleasure, through the kindness of Dr. L. O. Howard, of studying the collection of Aleurodidæ of the Division of Entomology of the United States Department of Agriculture. A considerable number of species have been met with that are undescribed, several of which are characterized in the present paper. So far as I have been able to ascertain, all American species of Aleurodidæ are indicated in the following pages; *Aleurodes vaporariorum* is included in this list; although originally described from Europe, it has now become quite common in greenhouses, in various parts of the eastern United States at least. In all cases reference is made to the original description of a species, and to such other references as are of any importance from a systematic standpoint. From a study of this literature it is at once apparent that the as yet meager study of American Aleurodidæ has been, for the most part, done during recent years. In the United States, for example, there were but three species recorded previous to 1884. Forbes, in 1884, described from Illinois *Aleurodes aceris*, which, however, should now be known as *forbesii* Ashmead, since *aceris* is preoccupied by a European species.[1] In 1893 Riley and Howard described *Aleurodes citri*, previously briefly described by Ashmead in the

[1]Monograph N. Amer. Proctotrypidæ, Bul. 45, U. S. Nat. Mus., p. 294.

Florida Dispatch, November, 1885. *Aleurodes pyrolæ* Gillette and Baker, was described in 1895; *Aleurodes berbericola* Cockerell, in 1896; *Aleurodes ruborum* Cockerell, and *Aleurodes aureocincta* Cockerell, in 1897. Since 1897 to date four species have been described from the United States, giving a total of thirteen, one an *Aleurodicus* and twelve belonging to *Aleurodes*. From the West Indies, Mexico, Central and South America twenty species have been recorded, seven of which are species of the genus *Aleurodicus* and thirteen of *Aleurodes*. Of these, six were described before 1895. It is evident, therefore, to any one who has observed the variety of forms in this family that our knowledge of American Aleurodidæ is still very imperfect, and, with the exception of *Aleurodes citri*, our knowledge of their life history and habits is even more incomplete.

The specific characters in the genus *Aleurodes* are derived mainly from the pupa-case, the adults, except in species with banded or spotted wings, offering but very little of use in characterization. In *Aleurodicus*, on the other hand, the most valuable specific characters are to be found in the adults, although to me there has appeared to be more variation in the pupa-case than has been generally stated. Ordinarily, the founding of species on the characters derived from immature stages of insects is unwarranted; but with this family, however, particularly in *Aleurodes*, as has been pointed out by Maskell and others, the pupa-case offers by far the more valuable characters, and it is doubtful if species could be satisfactorily separated, except in a few cases, from adult characters alone. Moreover, it is in the pupal stage that these insects are most frequently observed and collected, the minute "white-flies" that may be flying around being usually not associated with the stationary scale-like insects on the leaves. Again, injury is caused by these insects it is likely, mainly, in their immature stages, which fact, from an economic standpoint, renders it necessary that these stages be characterized. For these reasons the writer believes that the characterization of species of *Aleurodes*, at least, should be based largely on pupal characters; there is as much variation, probably, in the pupa-case of different species of *Aleurodes* as there is in the species of *Aspidiotus*, *Mytilaspis*, *Chionaspis*, or other genera of the *Coccidæ*. The writer by no means favors the disregard of the imagoes, and especial effort should be made by collectors to secure this stage. This ordinarily may be easily done, where the pupæ are somewhat numerous, by placing the leaves in a jar for a few days, to allow the more mature pupæ to develop into adults.

To preserve Aleurodidæ satisfactorily for study it is advisable to keep two series. As soon as material is collected, specimens of all stages should be mounted in xylol balsam on slides, after careful "live notes" have been taken, particularly with reference to the coloration of the different parts, and with adults as to the division or not

of the eyes. Soon after mounting, the relative lengths of the joints of the antennæ of adults are much more readily distinguished than later. The other series should consist of adults preserved dry in vials, and the infested leaves so pinned that the waxy secretion from the larvæ and pupa-cases will not be in any way damaged.

I am under obligations to Prof. T. D. A. Cockerell for bibliographic references, numerous specimens sent, and other courtesies; and I have been much aided by the careful entry notes made by Mr. Theodor Pergande on the material received by the Division of Entomology and kindly furnished me by Dr. L. O. Howard.

Family ALEURODIDÆ.

Small to minute insects infesting the leaves of plants, usually on the lower side; the immature stages scale-like; the adults with two pairs of wings, and covered or dusted with a whitish meal-like secretion of wax.

In the immature stages the body may be more or less covered by a secretion of wax, frequently quite copious. The most distinctive Aleurodid character in the larval or pupal stages is in the presence of a subovate, triangular or semicircular opening on the dorsum of the last abdominal segment, known as the "vasiform orifice." This consists of the orifice; the operculum, a more or less lid-like structure attached to the rim of orifice cephalad, and the lingula, a more or less slender tongue or strap-shaped organ, attached cephalad within the orifice and extending frequently quite beyond its caudal margin.

In the adults the mentum is three segmented, inclosing the three rostral setæ; antennæ seven jointed, the first two joints short and thick, the others slender and numerously ringed. Eyes usually somewhat constricted near the middle, dumb-bell shape or reniform, or even completely divided. Above each eye is a single ocellus. Tarsi two jointed, with three terminal claws, the middle one of which is short and small. The wings when at rest are nearly horizontal, extending caudad considerably beyond the abdomen, rounded distally. Both fore and hind wings may be immaculate or variously spotted or banded, usually with dusky or reddish.[1]

Genus ALEURODES Latreille.

With the characters of the family. Adults, with but a single basal branch to vein of fore wings; hind wings, with but a single vein.

[1] For a more detailed account of the characters of Aleurodidæ, see Maskell, Trans. N. Z. Inst., 1895, p. 415.

TABLE OF THE AMERICAN SPECIES OF ALEURODES.

I. Pupa-case usually but little hidden by secretion; with lateral fringe—*i. e.*, any secretion from marginal wax tubes.

II. Pupa-case usually hidden by a mass of hairy, waxy or flocculent secretion.

III. Pupa-case evident, and without lateral fringe.

I. Pupa-case usually but little hidden by secretion; with lateral fringe—*i. e.*, any secretion from the marginal wax tubes.

Pupa-case uniformly brown or black.

With dorsal secretion of wax. Dorsal secretion cottony or mealy in appearance.

Pupa-case dark brown to black, elliptical, slightly convex, about 0.85 mm. long. Dorsum covered with white meal, frequently becoming quite solid. Lateral fringe, all around, agglomerated almost into a solid plate, of unequal length, giving a star shape of about 8 rays. Operculum subcircular, covering about one-half of orifice; lingula obsolete.....*stellata* Mask. (37.)

Pupa-case black, elliptical, convex, 1.8 mm. long. Margin thick with conspicuous groove on dorsal surface, and short fringe of wax on ventral surface. Around vasiform orifice, a large, nearly transparent, hemispherical area, but dusted with white secretion. Around lateral margin, a row of about 32 sharp sword-like hairs. Adult ♀ with basal half and portions of rest of wing smoky. *fumipennis* Hempel (18.)

Pupa-case shiny black; size about 0.92 by 0.61 mm.; subelliptical, moderately convex; lateral fringe rather short, truncate; dorsal secretion of 3 longitudinal stripes of cottony or mealy wax. *acaciæ* n. sp. (3.)

Pupa-case dull black; subelliptical; 0.81 by 0.52 mm.; the copious lateral fringe, about twice the width of case in length. A slight mealy secretion may occur on dorsum; with tube-like longitudinal medio-dorsal elevation, cephalad, arrow-shaped; along abdominal segments, suggesting a trachea, with a glottis caudad. *tracheifer* n. sp. (38.)

Pupa-case shiny black, flat, subovate; 0.95 by 0.81 mm.; cephalo-lateral margins on each side with an indenture and thickening. Lateral fringe semitransparent; a very light mealy secretion of wax may occur along body segments. Dorsum with small black dots .....*quercus-aquaticæ* n. sp. (33)

Without dorsal secretion of wax.

Lateral fringe gelatinous looking (translucent).

Pupa-case pitch black, oval, hardly one millimeter long. The gelatinous fringe extending out from case, rather more than one-half width of case, and raising it up somewhat. From cephalo-lateral margin on each side and from caudal end a pencil of white wax resting on gelatinous rim.....*gelatinosus* Ckll. (19)

quercus-aquaticæ n. sp. See above.

Lateral fringe a series of distinct radiating waxy ribbons.

Pupa-case intense black, oval, hardly over a millimeter long. The lateral fringe of 12 broad ribbon-like rays of glassy wax, yellow basally, about as long as length of case.....*vinsonioides* Ckll. (41)

Lateral fringe a narrow, continuous rim of white waxen filaments.

Pupa-case dense black, broadly elliptical, 1.2 mm. long. Moderately convex, with rounded median ridge ..... *cockerelli* v. Ihering. (9)

Lateral fringe a more or less copious cottony secretion.

Pupa-case shiny black, elliptical, about 0.7 by 0.55 mm. A copious white cottony fringe all around, continuous basally, but ragged distally. Case moderately convex, with evident rounded median ridge. Fore-wings of adults marked with red and brownish black ..... *mori* Q. (24)

"Larva (Pupa-case?) flavous, the disk of the larger individuals dark brown; the margin is ciliate with white." Wings of adults immaculate ..... *corni* Hald. (10)

Pupa-case shiny black, subelliptical 0.7 by 0.55 mm. Dorsal disk larger than ventral, and the marginal rim of wax tubes bent downward and inward. The scant cottony secretion from marginal wax tubes appearing as a vertical fringe.. *abnormis* n. sp. (1)

tracheifer n. sp. See above.

Pupa-case yellowish, or greenish.

Dorsal secretion simply a submarginal series of brittle curved waxen rods from distinct pores or papillæ.

Pupa-case pale yellow, elliptical, about 0.56 mm. long, flattish. Margin minutely crenulated, the wax tubes bearing a short fringe of straight white tubes. Within the submarginal series of papillæ on dorsum, are 8 large circular orifices: 2 on cephalic, 4 on thoracic, and two on abdominal region..... *erigerontis* Mask. (12)

Dorsal secretion a submarginal series of curved waxen rods from distinct pores or pustules, and a more central secretion of thin, brittle, yellow wax, usually fragmentary.

Pupa-case, yellow, the median region at length darkening, elliptical, about 0.75 mm. long. With two lateral depressions on each side, similar to those in a *Lecanium*. Lateral fringe short, fragmentary. Within submarginal series of pustules on dorsum are 12 other pustules: 2 large on cephalic region, 2 large on thoracic region, 4 large on abdominal region, 2 large on caudal region, and 2 small at vasiform orifice..... *nicotianæ* Mask. (26)

Without dorsal secretion.

The lateral fringe, a delicate, white, band-like secretion.

Pupa-case pale greenish, oval, with margins anteriorly very sinuous; 0.5 mm. long. Within margin all around a parallel line the intervening space crossed by equidistant straight lines; a second parrallel line, often faint, within the first, the space thus formed also crossed by lines closer and shorter than in first zone. On ventral surface, near middle line are five pairs of strong setaceous hairs, all very long, and projecting mostly beyond the margin. Wings of adults immaculate; eyes large, black, bean-shaped... *filicium*, Göldi (13)

The lateral fringe consisting of but three curling, white waxen filaments, from long thickened tubular pores, opening, one on each side in cephalo-lateral region, and one at caudal end of case.

Pupa-case pale greenish yellow to yellowish, broadly oval, but little convex, applied close to leaf, and inconspicuous; 1.4 by 0.8 to 1 mm.; margin minutely crenulated, and with radiating lines extending mesad. Vasiform orifice, small, subcircular; operculum short, concave distally. Adults with immaculate wings ..... *citri* R. & H. (8)

II. Pupa-case usually hidden by a mass of hairy, waxy, or flocculent secretion.

The secretion white, felt-like, or hairy.

Pupa-case black, oval, 0.94 mm. long. Flat, but dorsum with a median ridge, and several transverse furrows. Margin with double crenulation. Vasiform orifice and operculum hemispherical; operculum small, not filling orifice. Wings of adult ♀ immaculate ..... *parvus* Hempel. (27)

Larva yellowish green, somewhat roundish, 0.5 mm. long. Margin with double crenulations which are pointed distally. Ventral surface with five pairs of bristles along middle line, about as long as one-third width of body. Pupa case with 10 to 12 long radiating wax threads, star-like ..... *goyabæ* Göldi. (20)

Larva similar to *goyabæ*, but only the caudal pair of bristles readily discernible. Pupa-case scantily covered with the unequal curling waxen threads. A submarginal series of equally spaced short bristles ..... *aëpim* Göldi. (4)

The secretion yellowish, long, hair-like.

Pupa-case light yellow, elliptical, 1 mm. long, flat. Denuded of the yellowish hair-like secretion, a longitudinal median, and submarginal secretion on each side of white wax is evident. Vasiform orifice subelliptical. Operculum hemispherical, nearly fitting orifice, the caudal end notched. Adult ♀ with wings immaculate, eyes black ..... *horridus* Hempel. (22)

The secretion white, flocculent.

Pupa-case dull yellow, elliptical, 0.56 to 0.84 mm. long, slightly convex. Margin conspicuously crenulated, the wax tubes bearing besides the flocculent matter a moderately long fringe of straight, white wax tubes. Dorsum with six long slender cylindrical spines, the caudal pair frequently bearing a pencil of white wax. Vasiform orifice twice as broad as long; operculum short, broad; lingula obsolete ..... *floccosa* Mask. (15)

The secretion of very long, curling bundles of snowy white wax in the form of a rosette.

Pupa-case yellowish, elliptical 0.78 by 0.5 mm.; the curling bundles of white wax from submarginal area, and a more or less columnar central secretion. A submarginal series of glassy, curved, waxen rods, from distinct papillæ; case raised on vertical fringe ..... *pergandei* n. sp. (28)

The secretion a submarginal series of broad waxy ribbons with a more central secretion, more or less columnar in appearance.

Pupa-case shiny black, sub-elliptical; 0.72 by 0.46 mm. The copious secretion, as a whole, rosette-like, the ribbons of wax rather long, curving outward and downward. Lateral fringe semi-transparent and agglomerated ..... *plumosa* n. sp. (31)

III. Pupa-case evident, and without lateral fringe.

Pupa-case more or less marked with brown or black, but not uniformly.

With dorsal secretion of wax from distinct pores or papillæ.

The secretion, a submarginal series, of brittle more or less curving waxen rods.

Pupa-case yellowish to whitish, with broad longitudinal mediodorsal band of dark-brown; elliptical, 0.7 by 0.43 mm.; raised on vertical fringe ..... *fitchi* n. sp. (14)

Pupa-case greenish white, but with a row on each side of more or less brownish spots; elliptical, 0.83 by 0.57 mm. The glassy rods,

from very closely set submarginal papillæ, and frequently as long as case is wide ..... *floridensis* n. sp. (16)

Pupa-case with a longitudinal medio-dorsal stripe, and a sub-marginal area of varying width whitish, otherwise brown, deepest laterad of central stripe; elliptical, 0.75 by 0.52 mm. The submarginal series of waxen rods rather short. No vertical fringe.. *vittata* n. sp. (42)

The secretion in part a submarginal series of sheathed bundles of small, curling, white waxen rods, from distinct groups of rather small pores.

Pupa-case with marginal, somewhat wedged-shaped, dashes of brown; two broad, longitudinal, interrupted, sub-dorsal bands of brown; subovate; 1.79 by 1.26 mm. A central and two lateral longitudinal matted exudations of wax. A very high vertical fringe ..... *altissima* n. sp. (5)

The secretion a submarginal series of glassy, curved, waxen rods from papillæ or pores, and similar rods more or less promiscuous on dorsum from circular pores.

Pupa-case yellowish to whitish, but with frequently a brownish coloration along dorsi-meson; elliptical; 0.72 by 0.45 mm. On the thorax the pores are promiscuous, but along abdomen are inclined to occur in longitudinal rows. Adults with wings marked with smoky black..... *rolfsii* Q. (34)

Dorsal secretion when present in form of a whitish, mealy exudation, or in extreme cases a matted plate of wax covering entire dorsum.

Pupa-case brown to brownish black, with 3 more or less evident transverse stripes of whitish: one at cephalic end, one at middle, and one at caudal end, crossing vasiform orifice. Ovate, to broadly elliptical, about 1.5 mm. long. Case raised quite high on vertical fringe of wax, about as high as one-half width of case. ..... *forbesii* Ash. (17)

Without dorsal secretion of wax.

Pupa-case yellowish-brown, and with more or less interrupted strips of dark brown along dorsi-meson; oblong to elliptical; 1 by 0.46 mm. On each side of median rounded keel, along abdomen, are large, irregular, toothed depressions, usually a pair to each segment. In adult ♂ wings immaculate; eyes divided; antenna with a long terminal process ..... *graminicola* Q. (21)

"Larva (pupa-case?) plane above and beneath; elevation about one-third the length, periphery vertical; pale flavous; the larger individuals with a conspicuous dorsal vitta" *abutilonea* Hald. (2)

Pupa-case, dorsally black but with a very broad lemon-yellow or whitish marginal area; oval, somewhat over a millimeter long. Adult ♂, with eyes completely divided; wings with suffused dusky spot, at end of vein, more evident on cephalic pair..... *aureocincta* Ckll. (6)

Pupa-case uniformly black.

The dorsal secretion, a submarginal series of glassy, curling waxen rods from distinct pores or papillæ.

Pupa-case ovate, about 0.8 mm. long. The glassy waxen rods in some cases almost if not quite as long as case is wide. Case with conspicuous vertical fringe. Adults with immaculate wings, eyes not completely divided ..... *ruborum* Ckll. (35)

The dorsal secretion, a submarginal series of short, truncate, white, waxy ribbons, with a more central secretion of columnar appearance.

Pupa-case shiny black, subelliptical, 0.92 by 0.66 mm. The submarginal ribbons, extending out at an angle of about 45°, giving appearance of an elliptical crown ..... *coronata* n. sp. (11)

Pupa-case, uniformly yellowish or whitish.

Without waxy secretion of any kind.

Pupa-case, pale straw-yellow, somewhat darker towards center, elliptical, 1.25 by 1 mm. Margin finely and densely wrinkled all around, the wrinkles extending radially inward to about one-half the length to the middle line, on the sides. Vasiform orifice darker than surrounding area, unequally triangular ..... *pyrolae* G. & B. (32)

Pupa-case (empty) colorless, oval, 0.75 mm. long. Margin radiately striate. Vasiform orifice an elongated triangle, the two sides nearly straight, and nearly twice as long as base. Operculum hemispherical or semilunar, concave at base. Lingula elongate, sub-spatulate. No conspicuous submarginal orifices. Adult ♀ with immaculate wings; head and entire body deep orange-yellow; legs pale lemon yellow. Eyes jet black, each one completely divided ..... *berbericola* Ckll. (7)

Pupa-case whitish, elliptical, 1 by 0.61 mm. Flat, marginal wax tubes evident. Vasiform orifice sub-cordate without corrugations; lingula terminating in subcircular lobe ... *nephrolepidis* n. sp. (25)

Pupa-case yellow to lighter, ovate, narrowed caudad; 0.81 by 0.55 mm. Somewhat convex, marginal wax tubes obscure. Vasiform orifice subtriangular, inner lateral margins corrugated; lingula arrow-shaped distally ..... *inconspicua* n. sp. (23)

Secretion present.

Dorsal secretion a submarginal series of glassy, curved, waxen rods from distinct pores of papillæ, and a more dorsal secretion of very long, tapering, curved, waxen rods, in pairs, from large circular pores.

Pupa-case yellowish, oval to elliptical; about 0.76 by 0.48 mm. The submarginal wax tubes rather short, and blunt. The very long rods from dorsum occurring: a pair very close to cephalic margin, a pair on cephalic region, a pair on thoracic region; two pairs on abdominal region; a pair at caudal end, and a pair just within margin, from caudo-lateral region. In adults rostrum reaching nearly to abdomen. Wings immaculate ..... *vaporariorum* Westw. (34)

With a rather copious, white, dorsal secretion.

Pupa-case yellowish, elliptical, 0.86 by 0.53 mm. With a short, downward curving, pearly white submarginal secretion of wax, hiding margin of case, and 3 prominent, more central, inward-curving columns set in a triangle. Operculum considerably broader than long; lingula spatulate, with 2 pairs of setæ near distal end ..... *persex* n. sp. (29)

pergandei n. sp. See above.

Dorsal secretion a variable submarginal series of glassy, curved rods from distinct pores of papillæ.

Pupa-case yellowish, elliptical, 0.65 by 0.36 mm., raised on vertical fringe of white wax. Vasiform orifice with rounded indenture caudad; lingula four-fifths length of orifice, with 3 pairs of lateral lobes and a distal lobe. In adults, wings immaculate ..... *variabilis* n. sp. (40)

rolfsi. See above.

Without dorsal secretion.

Pupa-case yellow, broadly elliptical, convex, 1.15 by 0.83 mm. A short, more or less slanting, fringe all around of white wax, doubtless homologous with vertical fringe. Vasiform orificé broadly ovate, lingula spatulate. Dorsum void of pores and papillæ. In adults, wings with a distal dusky spot ..... *spiræoides* n. sp. (36)

It has not been possible to indicate in the above table, the *Aleurodes phalænoides* of Blanchard, reported from Chile, in 1840. The description is meager, and based on the adult. In the Division of Entomology collection, are specimens of an *Aleurodes*, received through Professor Cockerell, from Mr. F. Lataste, Chile, under the name *Aleurodes phalaroides* Lataste. Possibly this is meant for Blanchard's *phalænoides*. Until more information is obtained on this point, and pending the finding of Lataste's description, it may be well not to consider *A. phalaroides* Lataste, as a distinct species.

1. Aleurodes abnormis n. sp. (Plate I, figures 1–3.)

Pupa-case.—Size, about 0.7 by 0.55 mm.; dense black, and cleared only after prolonged boiling in KOH. Shape, subelliptical, varying somewhat in outline. There is no lateral fringe, in the ordinary sense. The pupa-case becomes at length comparatively thick, and the dorsal disk is larger than the ventral. The marginal rim of wax tubes is bent downward and inward to the ventral surface of case, thus connecting the ventral and dorsal disks by an inward slanting rim. From this reflexion of the marginal rim the lateral wax tubes open directly against the surface of leaf, and the white cottony exudation of wax appears at first sight as homologous to the vertical fringe of wax, or palisade by which, in many species, the pupa-case is elevated from surface of leaf. This exudation is light, and does not elevate the case to any extent from the leaf. On the reflexed marginal rim the flutings of the wax tubes may be observed with varying distinctness up to the dorsal surface of case. Dorsum void of exudation of any kind. In immature specimens dorsum is concave, and there is a furrow all around just within margin of dorsum, the rim being quite prominent as a raised boundary line. Case at length becomes moderately convex. There is a pair of setæ on caudal end of case, and a pair just cephalad of vasiform orifice. Under hand lens the abdominal segments appear moderately distinct, and the straight suture, extending from third thoracic segment cephalad to margin of case, is quite distinct, and the margins on either side minutely sculptured. The vasiform orifice seen in boiled specimens is small, subcircular, with semielliptical operculum and small obscure lingula.

Adult ♀.—Length, about 0.77 mm.; fore-wing, 0.89 by 0.36 mm.; hind tarsus, 0.17 mm.; hind tibia, 0.29 mm. Color of body uniformly yellow, legs and antennæ paler. Eyes not quite divided, dorsal lobe

bright red, ventral lobe very dark reddish-brown. Fore-wings with smoky markings. There are two spots near middle of length of wing, one on the vein, and the other just within caudal margin; on the distal portion of wing are three spots, one at distal end of vein just within margin, and one on each side of vein. There is usually, also, an obscure spot just caudad of basal veinlet; hind-wings without spots. Antennæ of seven joints. Joint 1, short, wider than long, cup-shaped; joint 2, of usual subpyriform shape, about one-half as broad as long; joint 3, long, equal in length to distal joints together; joint 4, short, about one-half length of 5th; 5, 6, and 7, subequal in length; joint 7, somewhat fusiform. Front tibia two-thirds length of hind tibia; hind tarsus but little longer than front tarsus; hind femur about three-fourths length of hind tibia. Genitalia ordinary. Basal veinlet of fore-wings arising at base of wing and apparently distinct from main vein.

This species has been collected from various parts of Florida by the writer, on leaves of such trees as *Quercus aquatica*, *Q. virens*, *Q. catesbæi*, *Ilex opaca*, *Magnolia glauca*, and *Persea carolinensis*. The pupa-cases are much scattered and rarely occur more than two on a single leaf, and usually but one. Adult females bred out by the writer. Type in Div. Ent., U. S. D. A. Described from numerous pupa-cases and three ♀ specimens.

2. Aleurodes abutilonea Haldeman.

"White, body pale flavous, with a tinge of greenish; wings each with a single nervure, the superior ones with two irregular obscure bands across them, and a circular apical spot; eyes black, double upon each side, inferior ones large and prominent; thorax above, with large irregular fuscous spots; abdomen with 3 or 4 transverse lines of the same color; rostrum as long as the head, bi-articulate, apex black; antennæ with the basal articulation robust; feet with short hairs, slender, dimerous, one-half line long.

"*Larva* oval, plane above and beneath, elevation about one-third the length, periphery vertical; pale flavous, the larger individuals with a conspicuous dark dorsal vitta.

"Found upon the lower surface of the leaves of *Sida* (*Abutilon*) *abutilon*, to which the larva is immovably attached. It is sometimes so abundant that there are from 50 to 100 in half an inch square, causing the leaf to curl and die. The perfect insect is very active, walking and flying readily, and leaping from 1 to 1½ inches. It seems nearest allied to *A. bifasciatus* Steph. When the imago first appears the wings are more translucent and the dark fasciæ are entirely wanting, so that it might be taken for a distinct species.

"Burmeister's figure of *A. proletella* Linn. exhibits 2 nervures, probably because the wings were in contact when drawn, which, on account of their translucency, would allow the nervures of both to be

seen at the same time. Found in Pennsylvania from August to the middle of October." (Haldeman.)

Am. Jn. of Sci. and Arts., Vol. IX, 1850, p. 108. Signoret, Ann. de la Soc. Entom. de France, Dec., 1867, p. 397.

3. Aleurodes acaciæ n. sp. (Plate I, figures 4–7, and Plate VII, figure 68.)

Egg.—Size about 0.18 by 0.092 mm.; curved, yellowish, and marked with rather indistinct polygons. Stalk short, and attached somewhat to one side of the end, on the convex curve.

Larva.—Full-grown larvæ are difficult to separate from pupa-cases. Larvæ are brownish yellow, even when quite small, and secrete the marginal fringe of wax as in pupa-case. In older larvæ the marginal rim is quite evident, and the cylindrical tubercles are present, though not so numerous as in pupa-case.

Pupa-case.—Size about 0.92 by 0.61 mm.; shape subelliptical, narrowed somewhat, cauded and cephalad. Color on leaf, under hand lens, when wax is removed, shining black. Under microscope, by transmitted light, dark brown. In less mature specimens, case is flat, but later becomes moderately convex. There is a rather short and squarely trimmed marginal fringe all around from the lateral wax tubes, extending out flat on the surface of leaf. In the older specimens there is a dorsal white waxy secretion, which typically occurs in three longitudinal lines, a broad central one and a narrower stripe on each side. These lateral stripes may not extend but along the abdominal region, or frequently quite along the entire dorsum and more or less parallel to margin of case, forming somewhat of an ellipse. A transverse stripe of this exudation may occur on dorsum, thus uniting the three stripes.

Dorsum of case is much corrugated. In younger specimens a medio-dorsal ridge is evident, and on each side is a furrow. Centrally, the abdominal segments are quite distinct. There is a distinct and wide marginal rim, somewhat wider on the sides. This rim is plainly demarked from dorsum by a thickened line all around. The lateral wax tubes are quite prominent and extend mesad to near this thickened rim; the margin is crenulated, the incisions quite uniform and acute. There is on this marginal rim a row all around of short cylindrical papillæ. These are truncate distally and appear as short circular discs when seen from above. On caudal end of dorsum, just within margin, is a pair of slender setæ projecting somewhat beyond margin. The caudo-lateral pair is present, though slender and longer than usual. There is also on cephalic margin of case a pair of setæ quite similar to these latter.

Vasiform orifice small, tubercle like. Orifice subcircular, about as broad as long. Operculum relatively large, of the same outline as orifice, which it almost fills. Lingula about four-fifths length of orifice.

though it is made out with difficulty. On ventral surface, rudimentary feet quite distinct.

Adults unknown.

Received by the Division of Entomology at Washington from Dr. Vasey, of the Department of Agriculture, specimens on leaves of *Acacia* (mesquite) from Chilhua, Mexico, January 27, 1886; from W. E. Collins, Ontario, Cal., on *Acacia*, October 6, 1889; again on *Acacia* from Los Angeles, Cal., and on *Bursera microphylla*, Carmen Isle, off Lower California. This same species, it is stated in Mr. Pergande's notes, was found on leaves of mesquite from Bastophilus, Mexico; Div. Ent. No. 3863. No. 5876 is doubtless this same species, from Fullerton, Cal., July 30, 1893, on an undetermined plant. Type 3863, from Chilhua, Mexico. Described from numerous pupa-cases.

4. Aleurodes aëpim Göldi.

Mittheil. Schweitz. entom. Gesellsch., VII, 1886, p. 250.
On "Aëpim" ("Mandioca doce") Rio de Janeiro.

5. Aleurodes altissima n. sp. (Plate I, figures 8–12, and Plate VII, figure 70.)

Larva.—Size about 0.89 by 0.52 mm.; yellowish white. A series all around of about 30 setæ. On dorsum are 5 pairs of moderately developed setæ, a pair on cephalic segment, a pair on each of the thoracic segments, and a pair at vasiform orifice. Margin of case slightly crenulated. On the dorsum a few pores may occur somewhat promiscuously, and there are a few groups of pores around the margin. This stage in many respects approaches quite close in structure to the pupa-case.

Pupa-case.—Size about 1.79 by 1.26 mm.; subovate, narrowed cephalad. Color of younger pupæ, yellowish to white, and usually without other coloration. In more mature examples the color may vary from whitish to those more or less mottled with brownish, with extreme cases almost uniform brownish black, though in these latter cases such examples have plainly been parasitized, and this color may have resulted from this fact. Typically, this brownish coloration occurs in dashes, from the outer margin inward, varying distances, and more or less radially. Along the dorsi-meson there is a more or less clear longitudinal central stripe, with an interrupted stripe of dark brown on each side, these latter varying considerably in extent and distinctness In well-marked specimens the radial wedge-shaped dashes may extend quite into these subdorsal bands of dark brown.

Pupa-case, when young, with moderately rounded keel, otherwise flat; at length becoming somewhat convex, and raised on an unusually high vertical fringe of white wax. There is no lateral fringe, but just within the margin all around there is a series of groups of waxen rods. These rods arise from groups of from usually 22 to 26 circular pores. Each bundle of rods is surrounded with a rather short cylin-

der of wax, forming a sheath at base. Individually, the rods are rather small, glistening white, and inclined to curl at tip. These wax bundles vary considerably in length, but are, as a whole, short, curling outward and downward from the case. Along central dorsal region is a broad and somewhat matted secretion of wax extending from vasiform orifice to cephalic end and covering the rounded keel. On each side of this central dorsal secretion is a curved and narrower secretion extending from just laterad of vasiform orifice to cephalic end. These three dorsal lines of wax may be much interrupted transversely, particularly in younger examples, but in older cases each is usually continuous.

There is a very narrow marginal rim and the margin of case is minutely crenulated. Just within the margin all around is a series of rather long and slender tubercled setæ, about 30 in all, or 15 on each side. The pores of the submarginal groups are rather small, simple, and circular. These may vary considerably in number in the different groups, and an occasional pore occurs outside of group. These groups of pores are usually in the brownish coloration extending in from the margin. There is usually a group of very small pores on each side of vasiform orifice, and a very pretty group on each side of the second abdominal segment. This consists of an irregular circle of small pores with a central rotate figure. The usual series of brownish colored compound pores with cylindrical rim and central rod are present, though comparatively small. On caudal end 4 of these pores occur in almost a transverse row, caudad of orifice, and from this 3 extend cephalad on each side to about the fourth abdominal segment.

Vasiform orifice cordate, about as wide as long. Operculum subrectangular, about twice as wide as long. Lingula large, broad, spatulate shaped, extending quite to caudal margin of orifice and bearing the usual two pairs of subterminal setæ. Margin of orifice extended upward all round, but more pronounced caudad, into a thin and somewhat fluted rim. Operculum and lingula minutely setose or punctured. On the ventral surface the reduced legs and antennæ are quite distinct.

Adults unknown.

When the adult is discovered it will very likely prove to be an *Aleurodicus*.

Collected by Mr. C. H. T. Townsend, July, 1897, at San Francisco del Peal, Tabasco, Mexico, on a plant called "Palo de Gusano." Div. Ent., No. 7979. Described from numerous pupa cases.

6. Aleurodes aureocincta Cockerell.

Jn. N. Y. Ent. Soc., 1897, p. 42. On *Aquilegia*, Organ Mountains, New Mexico.

7. Aleurodes berbericola Cockerell.

Jn. N. Y. Ent. Soc., 1896, p. 207. On a shrubby *Berberis*, Mescalero Reservation, Tularosa Creek, New Mexico.

8. Aleurodes citri Riley and Howard.

Insect Life, Vol. V (1893), pp. 219–226.

Food plants: Orange, *Melia azederach*, *Viburnum nudum*, Cape jassamine, and occasionally on *Quercus aquatica*. Florida, Louisiana, and greenhouses generally.

9. Aleurodes cockerelli von Ihering.

"Os Piolhos Vegetaes do Brazil." Revista do Museu Paulisto, N. II., 1897, p. 393. On *Baccharis pauciflosculа*, Saõ Paulo, Brazil.

10. Aleurodes corni Haldeman.

"Size and general appearance of *A. abutilonea;* Body pale flavous; eyes black; wings pure white, without bands. Pennsylvania in September and October; the larva and imago on the inferior surface of the leaves of *Cornus sericea.*

"Larva flavous, the disk of the larger individuals dark brown; the margin is ciliate with white. A great many are destroyed in the larva state by *Amitus corni* Hald."

Am. Jn. of Sci. and Arts, Vol. IX (1850), p. 109. Signoret, Ann. de la Soc. Entom. de France, Dec., 1867, p. 398.

11. Aleurodes coronata n. sp. (Plate II, figures 13–15, and Plate VII, figure 69.)

Egg.—Size about 0.2 by 0.092 mm.; yellowish, considerably convex on one side; unmarked, stalk short, attached to egg at one side of basal end.

Larva.—Size about 0.55 by 0.37 mm.; pale yellowish white; subelliptical, becoming narrower caudad; abdominal segments but moderately distinct across the middle. No distinct marginal rim. Margin crenulated, the lobes somewhat truncate, and separated by linelike incisions.

There is a pair of setæ at vasiform orifice, and a pair just within caudal margin of case. There is also a pair on caudo-lateral margin of case and on the cephalic margin. There is no dorsal exudation of wax. Vasiform orifice practically as in pupa case. Legs and antennæ obsolete. Eye spots quite small and reddish.

Pupa case.—Size about 0.92 by 0.63 mm.; shape subelliptical as a rule, somewhat pointed cephalad, and broadly rounded caudad; widest about the middle, or just caudad of middle. Under hand lens case is shiny black in color; dark brown by transmitted light under microscope. There is ordinarily no lateral fringe, but there is a beautiful ellipse of white waxy bands or ribbons from the submarginal area of the dorsum. These project from the case more usually at an angle of about 45°, and are but little curved; they are truncate distally, of varying width, and rarely as long as the case is wide. There are along the longitudinal dorsal region three distinct white waxy secretions; at vasiform orifice is a concave shell-like plume or ribbon, one on each side of orifice, forming at base a much flattened tube, the

halves of which become spread out into a continuous broad ribbon at distal end. From the middle line of abdominal segments a perpendicular exudation arises which meets cephalad, a short, transverse, but thick column arising from last thoracic segment. At cephalic end is a pair of ribbons, rather narrow, and appressed together at top. The whole appears as an elliptical rosette or crown when viewed dorsally. Some specimens have what appears to be a secretion from the lateral pores. This is closely applied to leaf all around, and of a gelatinous appearance.

Margin all around finely crenulated with a double rim, the dorsal rim much more distinct and the incisions acute; the ventral rim of wax tubes are bluntly rounded and the incisions shallow and rather wide.

There is a narrow marginal rim of varying distinctness, with a series, within the margin, of small disk-like tubercles, quite similar to those in *acaciæ*, but smaller. There is also on the dorsum, on each side of middle line, a row of these tubercles; on the abdominal sutures there is a pair to each segment of dark-brown spots. On the margin, at cephalic end, is a pair of minute setæ, and the usual caudo-lateral pair; on the dorsum, at cephalic end of vasiform orifice, there is a pair of stout setæ, and a pair about midway between orifice and caudal end of case.

Dorsum slightly raised along dorsi-meson of abdominal segments and gradually sloping to margins. There are no submarginal furrows on dorsum as in *acaciæ*.

Vasiform orifice broadly elliptical, about four-fifths as wide as long. Operculum very short and obscure. Lingula quite short, stout, almost rudimentary. Operculum and interior of orifice thickly covered with minute black dots, possibly spine-like tubercles. On ventral surface rudimentary feet very distinct.

Received by the Division of Entomology, at Washington, D. C., from D. W. Coquillett, Los Angeles, Cal., December 5, 1887, on leaves of *Quercus agrifolia*, and again from Mr. Coquillett, same locality and same host plant, March 31, 1888; also from S. A. Pease, Pomona, Cal., on same host plant, September 14, 1896. Specimens of this insect were received also from Prof. J. H. Comstock, from Santa Rosa, Cal., on leaves of "live oak," October 7, 1880. Div. Ent. Nos. 4238 and 720.

This Aleurodid occurs in great abundance on the lower surface of leaves of *Quercus agrifolia*, and an occasional specimen may be observed on the upper surface. There is considerable variation in the amount of the white waxy secretion, particularly in younger pupæ, in which the dorsum may be almost bare. Described from numerous pupa cases. Type 4238, Los Angeles, Cal., December 5, 1887.

12. **Aleurodes erigerontis** Maskell.

Trans. N. Z. Inst., 1895, p. 429. Entom. News, Vol. VII, p. 247. On an *Erigeron*, Escalon, Mexico.

13. **Aleurodes filicium** Göldi.

Mittheil. Schweitz. Entom. Gesellsch., VII (1886), p. 247. See also Ent. Mo. Mag., 1891, p. 44. On *Asplenium cuneatum* and other Brazilian ferns, in the botanic garden at Rio de Janeiro; also on *Oleandra articulata* and *Pteris quadriolata* in the fern house, Kew Gardens.

14. **Aleurodes fitchi** n. sp. (Plate II, figures 16 and 19, and Plate VII, figure 71.)

Larva.—Size about 0.49 by 0.27 mm.; subelliptical in shape, narrowing somewhat caudad. Color clear whitish, with irregular blotches of orange. Eye spots reddish. There is no marginal fringe and the lateral wax tubes seem to be wanting, though the margin is somewhat undulate. Dorsum void of tubercles and pores and without waxy exudation of any kind. Vasiform orifice practically as in pupa-case. On caudal end there is a pair of strong tubercled setæ.

Pupa-case.—Size about 0.7 by 0.43 mm.; shape elliptical. Margin of case whitish. There is a broad longitudinal dorsal band of dark brown or smoky black, which will vary somewhat in width and distinctness, usually occurring on the entire medio-dorsal area of case. In extreme cases this coloration may be all but absent. There is no marginal fringe, though there is a narrow but well-marked rim of marginal wax tubes. The incisions between wax tubes very shallow, and the tubes distally are well rounded. In immature specimens the pupa-case is applied quite closely to leaf; in older specimens the case is raised on a vertical fringe or rim of white wax, which in some cases may be 0.2 mm. high. Dorsum almost flat, except a slight medio-longitudinal rounded keel or ridge. There is a submarginal row or series of short, broadly conical papillæ all around, varying considerably in position and number. From these papillæ rather short, more or less curved, glassy, waxen rods are produced, forming a fringe all around. There is a subdorsal series on each side of very minute circular transparent spots and a row on each side of keel, of depressions of irregular outline, but bounded cephalad, usually, by the straight margin of the preceding segment. In this respect this species approaches *graminicola*, though the depressions are smaller. Just within caudal margin there is a pair of well-developed setæ and a much smaller pair at vasiform orifice. Less usually there may be a pair of small setæ on the first abdominal segment and on the cephalic segment. Vasiform orifice subovate with caudal end somewhat truncate apparently, but under high power is seen to have a rounded indenture, thus producing two rounded lobes. Operculum about one-half length of orifice, subelliptical, broader than long. Lingula about three-fourths length of orifice; distally it is lobed, and distal four-fifths setose. From caudal

end of lingula arises a pair of upward-curving setæ. A narrow furrow extends caudad from orifice to margin of case.

Adult ♀. —Length, about 0.84 mm.; fore-wing, 1.07 by 0.49 mm.; hind tibia, 0.37 mm.; hind tarsus, 0.23 mm.; color of body, uniformly yellow, except the frons, which is deep brownish black, and the caudal margin of head, and certain thoracic sclerites; antennæ and legs paler; eyes deep red, constricted in the middle. Wings marked with two irregular bands of reddish brown. The proximal band crosses the wing near the middle of its length. Caudad of vein it has an irrregular V-shape, the apex of the V distad. Cephalad of vein the marking is of an irregular rhomboid shape. The distal band is somewhat narrow and interrupted as it crosses the vein. It crosses wing at about its widest part. A short distance distad of the caudal flexure of vein begins a narrow strip of this reddish-brown color, which extends along vein to its distal end, where it terminates in an enlarged spot. At base of wing, just caudad of veinlet, is also a small spot.

Antennæ 7-jointed; joint 1, short subpyriform; joint 2, also subpyriform, but much larger; joint 3, long cylindrical, four-fifths length of distal four together; joint 4, short, about one-half length of fifth; joint 6, somewhat shorter than 7. Mentum usual. Hind tarsus but slightly longer than anterior tarsus. Anterior and middle tarsi subequal in length. Operculum, when elevated and seen in lateral aspect, subconical, though somewhat more slanting cephalad than caudad. Lingula protruded, tapering, and with a sickle-like curve.

♂.—Length, about 0.67 mm.; genitalia ordinary; in other respects essentially as in female, but proportionately smaller.

Collected by Dr. C. V. Riley on cotton plant in his garden, Washington, D. C., October 4, 1879, and later at Selma, Ala. Also collected on leaves of cotton plant at Columbus, Tex., in July, 1879, and received by the Division of Entomology, United States Department of Agriculture, August 27 and September 14, 1895, from S. B. Mullen, Harrisville, Miss., also on cotton. The leaves received from S. B. Mullen are quite thickly covered on the lower surface with the pupa-cases. Concerning what is probably this same species in Mississippi, on cotton, Mr. W. H. Ashmead says:[1]

"This species lives on the leaves, and toward the latter part of July and the middle of August becomes exceedingly numerous, many hundreds occurring on a single plant, and when disturbed they fly up in powdery clouds. The eggs, from fifty to a hundred or more, are laid on the underside of a leaf without any regard to order, resembling those of the orange Aleurodes, only somewhat smaller, with a short pedicel, paler color, and with the surface perfectly smooth and shiny. These hatch in from four to five days, and the young larvæ attach themselves to the leaf and begin feeding on its juices. Although occurring by thousands, I could detect but slight injury caused by these insects."

[1]Insect Life, Vol. VII, p. 323.

I am unable to agree with Mr. Ashmead, in referring this species to Fitch's *Aleurodes* (*Aspidiotus*) *gossypii*. From a study of the single type specimen of *Aleurodes gossypii*, which was received by Dr. Fitch from Nigapo, China, certain important differences have appeared. There is no dark medio-dorsal stripe in *gossypii*, and the series all around of submarginal pores and waxen rods is also wanting. In *gossypii* the pupa-case is quite convex and the marginal area is strongly reflexed down to the margin of the leaf, much after the manner of a *Lecanium*. In *fitchi*, however, the case is scarcely at all convex, regularly elliptical in shape, and is raised on a vertical fringe all around of white wax. The two species are scarcely of the same type.

From the convexity of the single specimen of *Aleurodes gossypii*, I am inclined to regard it as representing the pupal stage, and not the larval, as regarded by Mr. C. L. Marlatt. (Ento. News, Vol. X, p. 146.) Div. Ent., Nos. 1163 and 1178. Type of larva and pupa-case, 1178, Harrisville, Miss., September 14, 1895. Described from numerous larvæ and very many pupa-cases. Type of adults, 1163, slide 2–1–47. Described from 3 ♀ and 2 ♂ specimens.

15. Aleurodes floccosa Maskell.

Trans. N. Z., Inst., 1895, p. 432. From Jamaica, on *Lignum vitæ*, in company with *A. stellata*.

16. Aleurodes floridensis n. sp. (Plate II, figures 20–22.)

Pupa-case.—Length about 0.83 mm.; width about 0.57 mm.; varying somewhat in size and the subelliptical shape. Color of fresh pupa-case, according to Mr. Pergande's note (Division of Entomology, No. 6962), "pale, semitransparent, greenish, marked on thorax and abdomen with subdorsal rows of blackish spots. Margin of body and anal plates yellowish." Dried specimens on leaf are pale lemon yellow, and the spots are deep red. In balsam the color of case is pale lemon yellow, and in more mature specimens there is more or less of orange, due, without doubt, to the developing imago.

There is no marginal or lateral fringe, in the strict sense of the word—that is, coming from the lateral pores—but on the extreme outer margin of dorsum all around there is a very closely set row of conical papillæ, from which originates a beautiful fringe composed of long, slightly curved, glassy, waxen rods—a rod from each papilla. These papillæ are very closely set, touching each other at their bases, and the rods are frequently nearly as long as the pupa-case is wide, and show basally, minute file-like serrations. The fringe is more or less separated into rays of rods extending mesad quite to case. There are usually from 3 to 8 rods in each ray, and these individual rays become somewhat curved, independent of the others.

Margin of case crenulated, the incisions between wax tubes usually quite shallow and acute. Pupa-case applied closely to leaf, and quite

flat at first, but as the pupa-case approaches maturity it becomes somewhat more convex. In dried specimens, particularly those that are immature, the dorsum shows two longitudinal ridges agreeing with the two rows of colored pustular spots. Abdominal segments distinct but not extending more than halfway to margin. The entire dorsum is marked with more or less radially arranged thickenings or reticulations. The two rows of pustular spots extend cephalad, on each side, from near caudal end to the head segment, forming an irregular ellipse, approximately parallel with margin of case. There are usually about ten of these spots on each side, though the number varies considerably, particularly in the thoracic region. In the abdominal region they are more distinct than elsewhere, where they occur approximately, one on each side, to each segment. Just within this series of spots, on the abdomen, somewhat smaller markings may occur. Dorsum with four pairs of minute tubercled setæ—one pair on cephalic portion, one pair on first abdominal segment, one pair at vasiform orifice, and one pair just within caudal margin.

Vasiform orifice cordate, but very little longer than broad. Caudal end bluntly rounded, but with a minute indenture. Operculum broadly cordate, about three-fourths as long as orifice, and minutely setose distally. Lingula moderately stout, spatulate, setose distally, and bearing on each side three small lobes, with a larger terminal one.

On ventral surface, rudimentary feet indistinct.

Adult.—Unknown.

Collected by the writer in August of 1898 on leaves of guava (*Psidium guava*) at Lakeland and Punta Gorda, Fla. Received by the Division of Entomology, United States Department of Agriculture, from H. G. Hubbard, Crescent City, Fla., January 8, 1896, and from H. J. Webber, Eustis, Fla., January 25, 1896, in both cases on leaves of guava. Also collected by J. H. Comstock, Arcadia, Fla., on "alligator pear." Div. Ent., Nos. 6962 and 413. Type 6962. Described from numerous pupa-cases.

17. Aleurodes forbesii Ashmead (*aceris* of Forbes).

Fourteenth Rept. Ill. St. Ent. (1884), p. 110.

This is the common large, box-like species, on leaves of *Acer dasycarpum*, in many parts of the North—Ithaca, N. Y.; Washington, D. C.; Urbana, Ill.

18. Aleurodes fumipennis Hempel.

Psyche, vol. 8, No. 280, p. 394. On undetermined grass growing on swampy ground, S. Paulo, Brazil.

19. Aleurodes gelatinosus Cockerell.

Can. Ent., Vol. XXX, p. 264. Dripping Spring, Organ Mountains, New Mexico, on what is probably *Quercus arizonica*.

20. Aleurodes goyabæ Göldi.

Mittheil. Schweitz. entom. Gesellsch., Vol. VII (1886), p. 248. On *Psidium goyaba* and *Laurus persia*, Rio de Janeiro.

21. Aleurodes graminicola Quaintance.

Can. Ent., Vol. XXXI, p. 89. On an undetermined grass, Lake City, Fla.

22. Aleurodes horridus Hempel.

Psyche, vol. 8, No. 280, p. 394. On *Psidium* sp., S. Paulo, Brazil.

23. Aleurodes inconspicua n. sp. (Plate II, figures 23–25.)

Egg.—About 0.17 mm. long. Oval in shape, uniformly brownish in color, unmarked. Pedicel very short.

Larva.—Size about 0.5 by 0.3 mm. Elliptical, tapering slightly caudad. In color light yellow, with a deep orange spot on each side of abdomen. Body flat, no marginal fringe, and without dorsal exudation. Margin of case practically as in pupa-case. There is a pair of well-developed setæ, projecting caudad from caudal margin of case, arising apparently on the margin. Dorsum void of setæ. Vasiform orifice practically as in pupa-case, but the furrow extending caudad from orifice to margin in the pupa-case seems to be wanting in the larva. There are two small reddish-brown pigment spots in cephalic region, marking the eyes.

Pupa-case.—Size about 0.83 by 0.55 mm. but varying somewhat. Oval in shape, broadest cephalad, and light yellow in color, the coloration deepening as the developing insect approaches maturity. Empty pupa-case colorless. On each side of abdomen in younger pupa-cases there is an irregular, oblong spot of deep orange yellow, evidently glands, within the body. As the pupa develops these spots tend to disappear. Case applied closely to leaf, at first flat, but later becoming somewhat convex. From its flatness and color it is quite inconspicious on the leaf. There is apparently no lateral fringe, and the vertical fringe raising the case from the surface of leaf, so common in aleurodids of this type, is in this species absent. Marginal wax tubes but little evident, and the incisions usually short and acute. From these incisions thickenings extend mesad some distance, producing an irregularly marked margin. There is a pair of small setæ on the caudo-lateral margin of case. Dorsum without exudation of wax; there is a more or less evident dorsal keel along dorsi-meson, more pronounced along abdomen. Some specimens show three rows of large circular pores; a row along dorsi-meson and a subdorsal row on each side. These pores vary much in position and number, and are more frequently not discernible. Dorsum without setæ, except a well-developed pair, arising from tubercles just within caudal margin of dorsum.

Vasiform orifice, subtriangular about three-fourths as wide as long; cephalic and lateral margins nearly straight lines. Lateral margins, with corrugations or folds, extending downward and inward. At caudal end of orifice there is a decided ental bend, or loop, of the rim, the orifice thus opening into a furrow which extends caudad to margin of case, between the two tubercled setæ.

Operculum subelliptical, about three-fourths as long as wide, and not quite one-half length of orifice. Lingula about five-sixths length of orifice, the distal two-fifths somewhat enlarged, and arrow-shaped, thickly setose, and terminating in two straight setæ, which reach quite to caudal end of orifice. Rudimentary feet on ventral surface quite distinct.

Adult ♀. Length, about 0.74 mm.; fore-wing, 0.846 by 0.35 mm., hind tibia, 0.32 mm.; hind tarsus, 0.17 mm.; color, bright yellow, abdomen paler, with a deep reddish-orange spot, due to visceral gland; legs and antennæ pale yellow. Wings immaculate. Eyes undivided, but somewhat constricted above the middle; dark brownish-red in color. Mentum usual; first joint, long, slender, widening gradually distad; second joint, short, thick, about one-third length of distal joint; distal joint, stout, gradually tapering from second joint to the blunt, brownish-colored point. Fore-tibia, six-elevenths length of hind-tibia; middle tarsus, four-fifths length of hind tarsus.

Vasiform orifice triangular. Operculum, when elevated and seen in lateral aspect, bluntly conical, and the caudal margin appears minutely setose. Lingula long, subcylindrical, tapering abruptly to an acute point; slightly curved, the convexity cephalad. Lingula apparently somewhat serrate, due doubtless to obscure setæ. In fore-wing, main vein nearer cephalic than caudal margin, extending distally about eight-ninths length of wing. Basal veinlet arising at very base of wing, apparently distinct from main vein, and extending obliquely caudad to margin of wing. Genitalia ordinary.

♂. Unknown. Collected by the writer on leaves of a species of *Physalis* at Bartow, Fla., July, 1897, and again in August of 1898 on leaves of cultivated okra at same place. Received by the Division of Entomology, United States Department of Agriculture, from Mr. E. L. Eames, Pomona, Fla., on leaves of sweet potato; Div. Ent. No. 6421. Adult females were bred out by the writer from pupæ collected on okra in 1898. Type of immature stages 6421, described from numerous specimens. Type of adult ♀, specimens bred out by writer from okra, August 15, 1898, 8 specimens. Types in Div. Ent. collection.

24. Aleurodes mori Quaintance.

Can. Ent., Vol. XXXI, pp. 1–4. On *Morus* sp. at Tampa, Fla., and at Lake City, Fla., on *Tilia americana, Callicarpa americana, Liquidamber styraciflua, Ilex opaca,* and less frequently on *Persea carolinensis.*

25. Aleurodes nephrolepidis n. sp. (Plate III, figures 26–30.)

Egg.—Size about 0.21 by 0.092 mm.; subelliptical. Stalk attached to one side of center of basal end, scarcely as long as egg is wide; stalk appears to be jointed, and barbed at basal end. Egg unmarked, yellowish.

Pupa-case.—Size about 1 by 0.61 mm.; elliptical; color, dirty white to yellowish. Empty cases in balsam are very pale yellow; eyes of

developing pupa bright red. There is no marginal fringe, or but very rudimentary. Margin of case crenulated, the wax tubes bluntly rounded; the incisions between tubes are but moderately deep and acute; rather light thickenings extend in from margin, and the thickened margins of the wax tubes may be discerned extending a short distance mesad. There is no distinct marginal rim. Pupa-case applied quite closely to leaf, and there is no vertical fringe. Dorsum almost flat, and void of waxy exudation, tubercles, or pores. Abdominal segments rather obscure, evident only about the middle one-half of case. There is a pair of well-developed setæ arising within caudal margin of case, extending dorso-caudad some distance beyond the margin. There is a pair of small setæ on cephalic margin of case, and a pair on caudo-lateral margin.

Vasiform orifice subelliptical in outline, and comparatively small. Operculum medium, subcircular, broader than long, about one-half length of orifice; cephalic margin straight. Lingula quite as long as orifice, frequently protruded, with distal subcircular enlargement, which is minutely setose; on ventral surface, legs moderately distinct.

Adult ♀.—Length about 0.97 mm.; length of hind tibia, 0.38 mm.; size of fore-wing, 1.12 by 0.43 mm.; length of hind tarsus 0.22 mm. Color, pale yellowish; eyes brown, slightly constricted at middle. Wings unspotted. Antennæ of seven joints. Joint 1 small, cup-shaped; 2, unusually long, somewhat more than three times length of first, pyriform; joint 3, slightly more than twice the length of second. Mentum, slender at base; first joint comparatively long, longer than 2 and 3 together; second short, not quite one-half length of third; third gradually tapering distad, but slightly constricted just proximad of the brownish black point.

Vasiform orifice cordate. Operculum not one-half length of orifice, convex dorsally, and on caudal margin concave, the margin thickly set with rather long setæ. Lingula protruded, and strongly bent as it extends out of orifice, gradually tapering from base to the strap-like distal portion, very thickly set with setæ.

In fore-wing, basal veinlet rather obscure, and arising apparently distinct from main vein. Margin of wings all around yellowish, but deepest on cephalic margin, where the color becomes somewhat reddish.

Received by the Division of Entomology at Washington from George C. Butz, Pennsylvania State College, November 19, 1898, on *Nephrolepis* with the statement that hundreds of the winged form are flying around in the conservatory of the college. A few of the imagos were bred out November 25 from the pupæ sent, by Mr. Pergande, from which the description of the adult stage has been made. This species is interesting as occurring on a fern. Div. Ent. No. 8210. Pupa-case described from numerous specimens; adult ♀, from 3 specimens.

26. Aleurodes nicotianæ Maskell.

Trans. N. Z. Inst., 1895, p. 436; Entom. News, VII, p. 247. On *Nicotiana tabacum*, Guanajuato, Mexico.

27. Aleurodes parvus Hempel.

Psyche, vol. 8, No. 280, p. 395. On *Maytenus* sp., S. Paulo, Brazil.

28. Aleurodes pergandei n. sp. (Plate III, figures 34–37, and Plate VII, figure 72.)

Pupa-case.—Size about 0.78 by 0.5 mm.; regularly elliptical in shape; pale yellow in color, but the empty case almost colorless. The most striking character of this species is the exudation from the dorsum of long, white, curled filaments or bundles of wax, forming a beautiful and relatively large rosette. Near the margin on dorsum is a series of long, curled, and slightly flattened bundles, which, extending outward and downward, touching surface of leaf, becoming irregularly coiled at the free end. So copious is this exudation that it may have a diameter of 3 mm., although the pupa-case itself is but 0.78 mm. long. From the central dorsum there is usually a stouter form of exudation, somewhat columnar, but not extending very high from case.

These bundles of wax are composed of many very minute glassy threads of wax, which in the longer lateral bundles become quite loose and separated on the lower surface of bundle.

On the dorsum, but very close to margin all around, is a series of rather closely set, more or less circular, pores. These occur about the diameter of a pore apart. From this series of pores is produced a fringe of rather long, tapering, and somewhat curved glassy rods. These project out laterally, around the pupa-case, as is usual in species of this type, but are hardly discernible until after the removal of the copious rosette of white wax from the dorsum. There is no fringe from the marginal wax tubes, although these form a distinct lateral rim. The margin is crenulated, with the incisions acute. There is a moderately developed vertical fringe, raising the pupa case up somewhat from surface of leaf. On caudal margin there is a pair of moderately developed setæ, and the usual small caudo-lateral pair of setæ is present. There is a pair of small setæ also at vasiform orifice. Vasiform orifice broadly ovate, almost as broad as long; cephalic margin straight, caudal end very broadly rounded. Operculum but little more than one-half the length of orifice, and wider than long; cephalic margin straight, and almost coincident with margin of orifice. Lingula about five-sixths length of orifice, stout, and broadly spatulate. Distal portion with three pairs of lateral lobes and a terminal lobe; also bearing a pair of setæ, which project caudad out beyond orifice. Distal portion of lingula setose in the usual way.

Adult ♀.—Length about 0.77 mm.; fore-wing 1.07 by 0.5 mm.; length of hind tibia 0.37 mm.; length of hind tarsus 0.23 mm. Color

of body light yellow, legs and antennæ paler. Eyes reddish brown, and apparently barely divided, each part subequal and subcircular in outline. Wings immaculate. Antennæ of 7 joints: Joint 1, short, usual; joint 2, subpyriform and obliquely truncated distally; joint 3, long, subcylindrical, about four-fifths as long as joints 5, 6, and 7 together; joints 5 and 6, subequal, and somewhat longer than joints 4 and 7, which are subequal. In hind legs, femur about three-fifths length of tibia, middle tarsus three-fourths length of hind tarsus. In fore-wing, basal veinlet arising at very base of wing, and apparently distinct from median. Genitalia usual.

Collected on the grounds of the Department of Agriculture at Washington, D. C., by Mr. Theodor Pergande on *Bignonia radicans*, September 3, 1881; at Washington, D. C., *Crataegus*, September 22, 1882; in Virginia, on *Hydrangea*, September 27, 1897. This same species was collected by the writer on plum, at Pomona, Ga., May 20, 1899, and on *Crataegus*, Flint River, Spalding County, Ga., during August, 1899.

This insect occurs either singly or in groups of three or four on the under surface of the leaves. It is at once one of our prettiest and most striking Aleurodids. I have pleasure in naming this species for Mr. Pergande. Div. Ent., Nos. 1002, 2861, and 7800. Type, No. 1002. Pupa-case described from numerous specimens; adult ♀ from 3 specimens; slide 1–32–39.

29. Aleurodes perseæ n. sp. (Plate IV, figures 38–40.)

Larva.—(Very young, probably in first stage.) Size about 0.338 by 0.18 mm.; subelliptical, very slightly narrowed caudad. Pale yellowish white, with more or less rectangular spots of orange in the abdominal region. Eye spots reddish. On the margin, cephalad of eyes, are six setæ, and on lateral margins of thoracic region are three on each side. On caudal margin are six setæ, the middle pair of which is considerably longer than others. On ventral surface, just within margin, all around, is a series of sparsely set small tubercled setæ. Legs and antennæ well developed. Vasiform orifice practically as in pupa-case.

Pupa-case.—Size about 0.86 by 0.53 mm.; shape subelliptical, with slightly undulate outline. Color under hand lens, yellowish brown; empty pupa-case practically colorless. There seems to be no lateral fringe, and the margin is not perceptibly crenulated, or but very indistinctly; no lateral wax tubes are to be observed, though there is a thickened line on the margin. There is a profuse dorsal exudation: First, a rather short, downward-curving fringe of pearly white wax, all around, arising from just within margin, and curling outward and downward over margin to near surface of leaf. This fringe is hardly continuous but is more or less split apart into ribbons or bands. See-

ond, a more dorsal exudation, composed of three thick, inward, and, at the tip, downward-curving columns. These occur in a triangle, one on each side and one at end. These columns of white wax are about as high as pupa-case is wide. The pupa-case is almost obscured by this exudation, when viewed from above. There is a short vertical fringe elevating the case somewhat from the surface of leaf. On the dorsum are 5 pairs of cup-shaped compound pores, four pairs on caudal third of case, and the fifth pair on cephalic segment, one near each cephalo-lateral margin of case. The margin or rim of each cup is thickened, and from within the cup there arises a rather large fluted cylindrical tube, extending upward, about one-half its length beyond rim of cup. Within tube at base is a short conical elevation. The entire structure is brownish in color. Dorsum void of well-developed setæ save a pair just within caudal margin. A pair of minute setæ occur on margin, near caudal end of case. There is, however, just within margin of case, all around a sparsely set row of minute, brownish colored, tubercled setæ. Vasiform orifice subcordate, about as long as wide, cephalic margin straight, coinciding with cephalic margin of operculum. Operculum subrectangular, the lateral margins somewhat rounded; considerably wider than long, and with caudal margin almost straight. Lingula relatively large, particularly distally, where it becomes broadly spatulate; longer than orifice, and bearing distally two pairs of setæ, the smaller pair proximad. Abdominal segments moderately distinct. Rudimentary feet and antennæ very evident.

Adult. The following note is by Mr. Pergande, made at the time of receiving the material at the Division of Entomology at Washington: "Wings of insect, of which one was found, transparent, colorless, without any marking, and they are covered with a white secretion, which gives them a milk-white appearance. The body is yellow, slightly reddish toward the tip of abdomen. Eyes dark brown." This specimen, mounted on a tag, had, unfortunately, become detached before it came into the writer's hands, but from the general structure of the pupa-case, particularly the vasiform orifice, and in the presence of the dorsal cup-shaped compound pores, it will probably prove to be an *Aleurodicus*.

On *Persea carolinensis*, from Dr. R. S. Turner, Fort George, Fla., April 22, 1880. Div. Ent. No. 495. Larva described from numerous specimens; pupa-case from three specimens.

30. Aleurodes phalænoides Blanchard.

Ins. Voy. du Chile, de Gay., 1840, p. 319. Also, see Ann. de la Soc. Ent. de France, Dec., 1867, p. 399.

31. Aleurodes plumosa n. sp. (Plate III, figures 31–33.)

Pupa-case.—Size about 0.72 by 0.46 mm.; shape subelliptical, but somewhat variable in outline. The shiny, black case, as seen under a

hand lens, is much hidden by the dorsal exudation of whitish waxen ribbons or plumes. Under microscope the case is very dark brown. These waxy ribbons, in perfect specimens, are quite twice as long as the case is wide; these occur usually from 3 to 4 on each side of dorsum and more or less continuous at base, extending upward and outward. There is also a central, upright, thick column, composed of the united exudations from the more cephalic of the abdominal segments. In the caudal pair the plumes are semi-tubular. From the suture extending cephalad to margin of case from the third thoracic segment, there arises on each side a thin ribbon of wax, the two united cephalad, and spreading distally into a broad wavy plume, and from between which arises a thin but broad plume. There is a lateral fringe of amorphous wax extending out in considerable quantity on the leaf, all around margin of case. Margin of case crenulated with a double row of wax tubes, the dorsal series somewhat within the lower. Just within the rim all around is a series of small dark-colored disc-like tubercles or dots, and small dots of this character may occur in transverse rows across the dorsum at about the middle of the segments. There are two pairs of well-developed, brownish-colored setæ at caudal end, a pair just within caudal margin, and a pair at vasiform orifice; on the margin of case there is a small pair in the usual caudo-lateral region, and a pair at cephalic end. Under high power of microscope the subdorsal area is seen to be covered with minute pores, from which is exuded the ribbons of wax. These pores also occur along the central abdominal line. Vasiform orifice subcordate, almost as broad as long; cephalic margin nearly straight, caudal end bluntly rounded. Operculum about one-third the length of orifice; lingula quite rudimentary, short, not more than half the length of operculum. Pupa-case but little convex, even at maturity. Body segments moderately distinct. On ventral surface, feet quite distinct.

Adult ♀.—Length about 0.86 mm.; fore-wing 0.95 by 0.33 mm.; length of hind tibia 0.24 mm.; length of hind tarsus 0.17 mm.; color, lemon yellow, legs and antennæ paler. Eyes but little divided, dorsal portion reddish; ventral, deep brownish red; wings immaculate. Joint 1 of antennæ short, not quite one-half length of second; joint 2, pear-shaped, about one-half as wide as long; joint 3, about as long as the four remaining joints together; joint 4, about two-thirds length of fifth; joints 5, 6, and 7, subequal in length; joint 5, somewhat swollen distally; joint 7, with a stricture on one side about the middle of its length, tapering to an acute point. Mentum of three joints, usual. Operculum seen in lateral aspect and when elevated, subconical; lingula considerably protruded subcylindrical, with an upward bend near middle, and nearer end there is another bend, but down to the horizontal.

A rather common species in Florida hammocks and higher woodlands; on leaves of various plants, as *Persea carolinensis*, *Magnolia*

grandiflora; M. glauca; Ilex opaca; Viburnum nudum and *Vaccinium* spp. Adults have been bred out by the writer. Pupa-case described from numerous examples; adult ♀ from two specimens. Types in Div. Ent. collection.

32. Aleurodes pyrolæ Gillette and Baker.

Prelim. Rep. Hemip. Colo., p. 125 (Colo. Agrl. Exp. Sta., Bul. 31, Tech. Ser.). On *Pyrola rotundifolia*, Four Mile Hill, 8 miles south of Steamboat Springs, Colo.

33. Aleurodes quercus-aquaticæ n. sp. (Plate IV, figures 41–44.)

Pupa-case.—Size about 0.95 by 0.81 mm.; shape very broadly suboovate, broadest about the middle. On the margin of case, on each side, in the cephalo-lateral region, there is an indenture, and a thickened and darker colored area on the marginal wax tubes. Cephalad from this rounded indenture the case is considerably narrower. Color under hand lens, shining black; under microscope by transmitted light, the color is brown, with the sutures dark brown. Pupa-case very flat, scarcely at all convex. There is a lateral continuous fringe all around somewhat longer than one-half the width of case. This fringe is applied closely to leaf, and is semi-gelatinous in appearance, the rods more or less indistinct basally, and frequently appearing as a structureless semi-transparent rim. From the indentures on the cephalo-lateral margin, on each side, and from the caudal end of case, pencils of white wax are exuded out into the semi-gelatinous fringe, and by contrast are somewhat conspicuous. On the dorsum, there may be a light and fragmentary exudation of wax along the body segments, but this is frequently absent. Margin of case, distinctly crenulated, and there are two series of wax tubes all around on the margin; these are quite close together, the dorsal series being almost superimposed. The somewhat transparent lines between the dorsal series of wax tubes, extend mesad with varying distinctness to a very faint line all around, morphologically equal to the inner margin of rim. Light-colored lines may extend mesad from this line, laterally, to the body segments, but hardly continuous with the lines between wax tubes. Dorsum with very small black dots, occurring in a broad and loose band on each side of dorsum, the bands of each side terminating cephalad at the transparent eye spots, and coalescing caudad at the vasiform orifice. Along the sutures of body segments narrow lines of these dots occur, usually on both sides of the suture.

Centrally, the body segments are quite distinct; the third thoracic segment bends cephalad on each side to near the thickened areas on the marginal indentures of case. On the dorsum, near the outer limit of the abdominal segments, is a row on each side of very small transparent spots. There is a pair of small setæ just cephalad of vasiform orifice, and a pair just within caudal margin of case, a seta on each side of the thickened marginal patch of tubes, from which orig-

inates the caudal pencil of white wax previously mentioned. Vasiform orifice can not be made out with certainty, but it is relatively small, short, and about twice as wide as long, and is surrounded with an obscure fluted rim.

Adult ♂.—Length about 0.86 mm.; fore-wing 1 by 0.46 mm.; immaculate. Body yellow, eyes reddish and dumb-bell shape, not divided. Antennæ, joint 1, short, cup-shaped; joint 2, subpyriform, about two-thirds as wide as long; joint 3, quite long and relatively large, cylindrical, except at base, where it is tapering, not quite as long as joints 5, 6, and 7 together; joint 4, short, about one-half length of fifth; joints 5 and 6, subequal in length; joint 7, slightly longer than joint 4. Mentum much reduced in size, plainly abnormally reduced. Genitalia usual; valves strong and clasping at tip; penis curved upwards, tapering, and enlarged at base.

This species occurs more or less singly on leaves of *Quercus aquatica*, on the campus of the Florida Agricultural College, at Lake City. Pupa-case described from numerous specimens; adult bred out by the writer, from one specimen. Types in Div. Ent. collection.

34. Aleurodes rolfsii Quaintance.

Can. Ent. Vol. XXXI, p. 90. From Upola, Fla., on cultivated Geranium.

35. Aleurodes ruborum Cockerell.

Jn. N. Y. Ent. Soc., Vol. V., No. 11, p. 96. See also Ann. Rept. Fla. Agr. Expt. Sta., 1898, p. 66. On cultivated *Rubus*, Lake City, Fla. Also occurs on *Rubus cuneifolius* at Lake City and San Mateo, Fla.

36. Aleurodes spiræoides n. sp. (Plate IV, figures 45–49, and Plate VIII, figure 74.)

Larva.—Size about 0.78 by 0.52 mm.; subelliptical in shape, becoming narrower caudad. Color, light yellow. In very young larvæ there is a rather narrow cottony marginal fringe, but in older specimens this is in most cases wanting. The margin is flat and closely applied to leaf. Abdominal segments moderately distinct; thoracic segments obscure. Margin of case delicately crenulated, the ends of the wax tubes rounded, and the shallow indentures acute. Dorsum void of pores, papillæ, and setæ. There are, however, three pairs of setæ on margin: A small pair at cephalic end, a well-developed pair at caudal end, and a small pair at caudal end, a seta on each side of larger pair. There is no marginal rim. Vasiform orifice essentially as in pupa-case. On ventral surface the legs are quite obscure. The small eye spots are reddish.

Pupa-case.—Size, about 1.15 by 0.83 mm.; broadly elliptical in shape, and bright lemon-yellow in color. In the more mature specimens there is more or less of reddish coloration, due to the developing pupa within. Pupa-case rather strongly convex, and but little flattened at the margin. There is no lateral fringe, but a more or less slanting waxen rim is present in older specimens, raising the case a short distance from

surface of leaf. This waxen rim is doubtless homologous to the vertical fringe of certain species, and may vary in direction from vertical, underneath the case, to a lateral fringe, having the general appearance of a true lateral fringe. In the removal of dried specimens, this waxen rim usually remains attached to the leaf. Margin of case crenulated by a narrow rim of closely set wax tubes. On cephalic margin a pair of small setæ may occur, and a pair also on caudal margin. Just within caudal margin on dorsum, caudad of vasiform orifice, there is a somewhat larger pair. Dorsum without pores and papillæ, and there is no dorsal waxy secretion. The abdominal segments are but moderately distinct; thoracic segments obscure.

Vasiform orifice broadly ovate, almost as broad as long. Operculum less than one-half length of orifice, subtrapezoidal, cephalic margin straight, caudal end truncate. Lingula extending nearly the length of orifice, spatulate, the enlarged distal portion minutely setose. Distal end bearing two small lobes. Two long setæ arise from ventral surface of distal end of lingula and project caudad out beyond the orifice. Just cephalad of vasiform orifice is a bow-shaped thickening of the tegument of case.

Adult ♂.—Length about 0.95 mm.; fore-wing, 1.38 by 0.56 mm.; length of hind-tibia, 0.46 mm.; length of hind tarsus, 0.3 mm. Color, as given by Mr. T. Pergande, on fresh material: "The winged insects are covered with a white bloom; the front wings have two rather indistinct dusky spots, one a little beyond the middle and the other near the apex, and one near apex of posterior wings; this bloom is easily rubbed off, and the insect appears then to be yellow or greenish-yellow. The eyes are reddish-brown and the legs and antennæ more or less dusky. The thorax is marked with blackish, and the abdominal segments 3 to 7 have each a blackish transverse band, which becomes gradually broader toward the end of the body. Vertex and front of head blackish. Veins slightly yellowish."

Antennæ of 7 joints: Joint 1 short, subglobular; 2, about twice length of 1, and subpyriform, obliquely truncate distally; 3, long, subcylindrical, as long as joints 4, 5, and 6 together. Joints 5, 6, and 7 subequal. Joint 4, slightly shorter than 5. Mentum with three joints, usual. Tibia of second pair legs two-thirds length of tibia of third pair, the latter about equal in length to an antenna. Operculum convex, more than twice as broad as long. Lingula protruded, rather swollen, cylindrical, and bluntly rounded, protruding about one and one-third times the length of operculum.

Eyes much constricted near the middle, but hardly divided. Wings obscurely marked with dusky: On fore-wing an obscure spot may occur along main vein at its distal end, and another spot a little distad of middle. On hind-wing there is an obscure spot at distal end of vein. In fore-wing, basal veinlet arising from base of wing, and apparently

distinct from main vein. Genitalia forcipate; valves rather short and stout. Penis about four-fifths length of valves, somewhat enlarged at base, where it curves upward; distally it becomes abruptly narrowed to an acute and curved point.

Insects received by the Division of Entomology at Washington, from several correspondents in California, as: Alexander Craw, Los Angeles, October 23, 1880, on leaves of *Fuchsia*, which, it is reported, were badly infested; D. W. Coquillett, Los Angeles, October 21, 1887, on *Sonchus;* A. Koebele, Alameda, during November of 1887, on *Convolvulus occidentalis;* A. Koebele, Alameda, November 5, 1885, on *Malvia rotundifolia*. Specimens also collected by Prof. J. H. Comstock, on *Iris*, October 20, 1880 (locality not given). Div. Ent. Nos. 750 (on Iris); 741 (on Fuchsia); 328 (on *Convolvulus occidentalis*); 4218 (on *Sonchus*), and 37 (on *Malvia rotundifolia*).

Pupa-case approaches *citri* in color and outline, but is much more convex, and differs in having a vertical fringe, in the absence of the cephalo-lateral and caudal indentures and thickenings of the margin, and the vasiform orifice is widely different. It also approaches *spiraea* of Douglas, but differs in the absence of abdominal rows of tubercles and in the presence of setæ at vasiform orifice. (Div. Ent. Nos., 37, 328, 741, 750, and 4218.) Type of all stages 741. Immature stages described from numerous specimens; adult ♂, from six specimens.

37. **Aleurodes stellata** Maskell.

Trans. N. Z. Inst. 1895, p. 442. On *Lignum vitæ*, in company with *A. floccosa*, Jamaica.

38. **Aleurodes tracheifer** n. sp. (Plate V, figures 50–52, and Plate VIII, figure 73.)

Pupa-case.—Size about 0.81 by 0.52 mm.; subelliptical, slightly narrowed cephalad. Color, under hand lens, rather dull black; under microscope, deep brownish in color, with the narrow marginal rim all around much lighter. There is a copious, white, somewhat cottony, lateral fringe, which may extend out, flat on the leaf, quite twice the width of pupa-case. Basally this forms a continuous fringe all around, but becomes separated into several lobes from about the basal third out. Lateral wax tubes very prominent, rounded distally; the incisions about as deep as tubes are wide and rounded at base. On the dorsum there may occur, along the middle line, a light mealy exudation. There is along the dorsi-meson an evident rounded keel extending cephalad from vasiform orifice to margin of case, but not so pronounced in the thoracic region, where cephalad, it becomes widened out suddenly into an arrow-shaped figure. Along the abdominal segments it is semitubular, and merges caudad into an ovate rim around the vasiform orifice, the whole producing somewhat the appearance of a trachea (windpipe), with voice box (the vasiform orifice) attached. There is in the thoracic region on each side, a short distance within the margin, a curved, depressed line, extending caudad to about the sec-

ond abdominal segment. Abdominal segments distinct, extending out to marginal rim, and strongly reflexed caudad.

Dorsum with four pairs of well-developed setæ: a pair on cephalic region; a pair on metathorax; a pair at vasiform orifice, a seta on each side, and a pair on the caudal end of the large, thickened, subovate rim, surrounding the vasiform orifice. There is a pair of minute white setæ on the cephalic margin of case, and the usual caudo-lateral pair is present. Vasiform orifice semicircular, as broad as long; cephalic margin almost straight. Operculum subsemicircular, but broader than long, minutely setose distally. Lingula moderately developed, reaching caudal margin of operculum; enlarged distally and minutely setose. The operculum and lingula are made out with difficulty.

Adults.—Unknown.

Sent to the Division of Entomology at Washington, June 2, 1897, on "Escabillo," collected at Las Minas, Tobasco, Mexico, by Mr. C. H. T. Townsend; Div. Ent. No. 7817. Described from 6 specimens.

39. Aleurodes vaporariorum Westwood.

Gard. Chron., 1856, p. 852; Signoret, Ann. de la Soc. Ent. de France, Dec., 1867, p. 387; W. E. Britton, Ninth Ann. Rept. Conn. Agr. Expt. Sta., 1895, Pt. II, p. 203.

A species widely distributed in Europe, and has been recorded on *Gonolobus*, *Tecoma*, *Bignonia*, *Aphelandra*, *Solanum*, Tomato, *Salvia splendens*, and *Lantana Camara*. Specimens have been received by the Division of Entomology, United States Department of Agriculture, of what appears to be this species, from the following localities in the United States: Freehold, N. J., on *Fuchsia;* Fairburg, Ill., on *Fuchsia;* Boston, Mass., on *Fuchsia*, *Pelargonium*, and other plants; New Haven, Conn., on Tomato; Storrs, Conn., on house plant; West Grove, Pa., on *Oxalis*, and what is probably the same species, from Goshen, Ind. These insects, to a considerable extent, occur on greenhouse plants, which fact probably has a bearing on their present distribution.

Div. Ent. Nos. 1192, 2124, 2224, 4354, 4590, 4895, and 6755.

40. Aleurodes variabilis n. sp. (Plate V, figures 53–55.)

Egg.—Length, exclusive of stalk, 0.2 mm.; width one-fifteenth mm.; shape oblong, tapering toward apical end, which is bluntly rounded, and about one-half the width of egg at widest part; unmarked; color whitish when fresh; with advanced embryo, yellowish. Stalk about one-sixth length of egg, attached to center at base, bearing several short irregular prongs.

Larva.—Length, 0.5 mm.; width, 0.3 mm.; regularly elliptical in outline, flat. Color, uniformly light yellowish. Wax tubes, seen from above, rounded distally. No marginal fringe. Abdominal segments moderately distinct; thoracic, less so. No pores or papillæ, as in pupa-case. There is a pair of well-developed, brownish-colored setæ arising from caudal margin, and extending dorso-caudad, as in pupa-case;

a pair of minute setæ is sometimes present on second abdominal segment and on prothorax near dorsi-meson. Vasiform orifice practically as in pupa-case.

Pupa-case. Length, 0.65 mm.; width, 0.36 mm., varying somewhat; regularly elliptical. Under hand-lens on leaf, small, yellowish, due to developing pupa within; more or less mottled with orange. Empty case, clear white. Very young pupa-case flat; after drying, may become concave. Older pupæ raised on vertical fringe of white waxen rods, the length of which varies with the age of the pupa. Mature pupa-case, somewhat convex above; inclosed pupa bright yellow, with the eyes brownish red. Margin of case crenulated, somewhat irregularly, by shallow incisions between the wax tubes. No marginal fringe; a pair of small setæ near caudo-lateral region. A narrow marginal rim may be distinguished. Abdominal segments moderately distinct; those of thorax less so. Four pairs of brown setæ may occur near dorsi-meson. These may be all long and equally developed, or any or all pairs may be reduced to mere traces. Usually the caudal pair is well developed; it is situated within the caudal margin and extends dorso-caudad some distance beyond case. The first pair, situated on thorax, is usually reduced, or quite obliterated, as may be also, but less frequently, the second pair on the second abdominal segment. The third pair is situated near the vasiform orifice, a seta on each side, near its cephalic margin. This pair is not infrequently as well developed as caudal pair, but usually less so. There may be a submarginal row all around of rather closely set papillæ, each bearing a white, waxen, curved rod. Circular pores may also occur in this row of papillæ, the two intergrading. Just mesad of this row of papillæ, pores may occur irregularly, similar to those in the submarginal row, and from which also arise white, waxen, curved rods. Usually these papillæ and pores are not discernible, or but faintly; those of the caudal and cephalic margins persist longest. When but discernible, there are no rods. All gradations may occur from the entire absence of pores and papillæ to a complete set, bearing rods.

Vasiform orifice large, ovate, broad end cephalad; a rounded indenture on caudal end. Orifice about four-fifths as wide as long. From the inside of the lateral and caudal margin distinct corrugations, or folds, extend downward and inward in the orifice cavity. Operculum somewhat semielliptical in outline, about two-fifths the length of orifice and about twice as wide at base as long. Lingula well developed, about four-fifths as long as orifice; the basal part is about one-fifth of its length, with thickened, centrally curving margins; the succeeding two-fifths is subrectangular in outline as seen from above; distal two-fifths enlarged, with three lobes on each side and a distal lobe; distal four-fifths, setose, thicker on distal portion; from distal end arises below a pair of well-developed upward curving setæ, pro-

jecting caudad to margin of orifice. Just cephalad of orifice are two sets of crescent-shaped thickenings. A shallow furrow extends caudad from orifice to margin of pupa-case. On ventral surface, the reduced legs may be made out with difficulty.

Adult ♀. —Length about 0.833 mm.; length of front wing, 0.95 mm.; width, 0.33 mm.; length of antennæ, about 0.25 mm.; length of hind tibia, 0.3 mm.; length of hind tarsus, 0.216 mm.; color, lemon yellow; feet and antennæ, lighter; wings, immaculate, anterior margin of both pairs, reddish. Eyes, brownish black. Antennæ, seven jointed; joint 1, very short, about one-third as long as second, subconical, distally somewhat obliquely truncate; joint 2, pear shaped, not quite twice as long as wide, oblique distally; joint 3, long, slender, as long as 4, 5, 6, and 7 together, subcylindrical, bearing distally on outer side a group of setæ; 5 and 6, club-shaped; 7, somewhat fusiform, but tapering abruptly, distally bearing a terminal seta on distal oblique margin. Joints 3 and distad, coarsely ringed.

Hind femur two-thirds length of tibia; tarsus about two-thirds length of tibia; distal joint of tarsus, excluding claw, two-thirds length of proximal; trochanter bearing two long setæ on caudal side. Mentum, three jointed; basal joint about as long as other two, gradually widening distally; second joint about one-half as long as third; third joint tapering gradually to blunt point, which is tipped with black.

Vasiform orifice, subcircular, as seen from above; operculum slightly convex; concave on caudal margin, which is minutely setose; lingula protruding, gradually enlarged distally, minutely setose. Genitalia, usual. Eyes oblong, somewhat constricted near middle. In first pair of wings the main vein is long, extending nearly to tip, becoming gradually fainter from distal half. A basal veinlet arises from base of wing, and extends obliquely backwards to margin. Margins of both pairs of wings delicately beaded all around. A short row of setæ on cephalic margin of second pair at base, the distal two of which are three or four times longer than the others.

♂. —Length about 0.5 mm.; proportionately smaller than female. Genitalia forcipate, the valves strongly curved at tip; penis tapering, a little more than one-half the length of valves, strongly curved upward, the strongest curve near base.

This species is exceedingly abundant on the common papaw (*Carica papaya*) at Miama, Florida. The under surface of the leaves of the plant are frequently quite covered with the pupa-cases, larvæ, and eggs. The adults are also exceedingly abundant, usually resting on the under surface of the younger leaves. The different stages described from numerous specimens. Types in Div. Ent. Collection.

41. Aleurodes vinsonioides Cockerell.

Psyche, Vol. 8, No. 266, p. 226; Frontera, Tabasco, Mexico.
On undetermined tree.

42. Aleurodes vittata n. sp. (Plate V, figures 56–58.)

Egg.—Size 0.25 by 0.09 mm.; slightly curved; color, pale yellow, unmarked. Stalk very short.

Larva.—Size 0.52 by 0.33 mm.; shape subelliptical, somewhat narrowed caudad. Color whitish, very flat, and closely applied to leaf. No lateral fringe; margin finely crenulated, but without distinct marginal rim. Dorsum void of waxy exudation. From caudal end projects a pair of moderately stout tubercled setæ. Vasiform orifice practically as in pupa-case.

Pupa-case.—Size about 0.75 by 0.52 mm.; shape elliptical. Color dark brown, with the margin of dorsum all around, and a broad stripe down dorsi-meson, whitish. The coloration is usually deepest just laterad of the central dorsal stripe, and gradually fading toward the margin.

Body segments quite distinct, the thoracic more so than abdominal, appearing as white lines extending across the dorsum.

There is no marginal fringe, although the lateral wax tubes are well developed. Just within the margin, all around on the dorsum, is a closely set series of short papillæ, or pores, from which is produced a fringe of rather short, slightly curved, glassy waxen rods. These are longest on cephalic and caudal margins. Along lateral margin, at more or less regular intervals, longer and stouter wax rods are produced. Just within this submarginal series of papillæ is an irregular row all around of small transparent spots, and these may also occur somewhat promiscuously over the dorsum, but are most numerous over the central dorsal portion. Around the sub-dorsal area the case is marked with more or less reticulated lines, which extend out plainly to the sub-marginal series of pores. Pupa-case applied quite closely to leaf, and there seems to be no vertical fringe. On the margin, at caudal end of case, there is, on each side of the furrow from the vasiform orifice, a moderately stout seta, and the usual caudo-lateral pair is present on margin of case. Vasiform orifice subovate, about four-fifths as wide as long; the inner lateral margin much corrugated. Operculum subelliptical, scarcely one-half the length of orifice. Lingula about three-fourths length of orifice, subspatulate, the distal part with three pairs of lateral lobes and a terminal lobe. Two setæ arise from caudal end of lingula, and project caudad to margin of orifice. Both operculum and lingula minutely setose distally.

Adults.—Unknown.

This species occurs on leaves of chaparral, and has been received by the Division of Entomology at Washington, D. C., from W. E. Collins, Ontario, Cal., July, 1894; A. J. Cook, Claremont, Cal., August 14, 1894; and from S. A. Pease, Pomona, Cal., August 30, 1894. Div. Ent. No. 6311. Described from three eggs, three larvæ, and numerous pupa-cases.

Genus ALEURODICUS Douglas.

With the general characters of the family, but differing from *Aleurodes* in having the vein in both pairs of wings with a distal and basal branch.

TABLE OF SPECIES OF ALEURODICUS.[1]

Wings of adults immaculate.

♀—Length 2.1 mm.; wing expanse 4.1 mm.; length hind tibia 0.78 mm.; length hind tarsus 0.36 mm.; dull honey yellow with eyes darker. Joint 3 of antennæ as long as the three distal joints together, and twice as long as joints 1 and 2 together. Pupa-case secreting an abundance of white wax and very long glassy filaments, ovate, or very broadly elliptical; compound pores smaller than in *anonæ;* operculum but moderately concave on caudal margin; lingula broad, tapering to rounded end; not notched distally.....*cocois* Curtis (4)

Similar to preceding, but larger. Length of fore-wing 3 mm; length hind tibia 0.96 mm.; length hind tarsus 0.47 mm. Pupa-case more nearly elliptical and the compound pores larger than in *cocois;* operculum on caudal margin suddenly indented and then straight; lingula comparatively narrow, notched distally, and tapering to rather acute point. *anonæ* Morgan (1)

Wings with a dark spot in angle of distal bifurcation of vein.

Head, thorax, and abdomen pale yellowish white. The dark spot of fore-wings, an obtuse angle, opening distally. Posterior wings with similar but fainter spot. Eyes brown, two-parted. Tarsi long, exceeding two-thirds length of tibia. Pupa-case secreting a white downy wax. *asarumis* Shimer (2)

Similar to *asarumis*, but with body and legs of deep chrome yellow; eyes not divided, but dumb-bell shape. Fore-wing 2 mm., noticeably iridescent; spot on fore-wings of rather indistinct outline, and extending cephalad to margin of wing as a very dilute clouding. Hind-wings unspotted. Pupa-case dark gray or plumbeous, varying to brownish, surrounded by abundant cottony secretion; along midrib of leaf, as in *pulvinata;* operculum very broad, broadly truncate distally; lingula spatulate, tapering to a rather rounded point.....*iridescens* Cockerell (6)

♂—Both pairs of wings with a distinct brownish-black spot; fore-wings with an ill-defined clouding all around margin, appearing centrally as an oblique, very obscure band. Length 0.86 mm.; fore-wing 1.1 by 0.52 mm. Eyes reddish, not divided. Genitalia very much reduced, valves short and stubby. Pupa-case subelliptical; cephalic and caudal pairs of compound pores largest; operculum well rounded on caudal margin; lingula spatulate, gradually tapering to somewhat rounded point. *minima* n. sp. (7)

Wings variously spotted or banded with gray or blackish.

Wings with more or less rounded spots.

Color bright yellow, legs and antennæ paler. Length, 1.23 mm.; length fore-wing, 2.4 mm.; with submarginal series of blackish spots, and more circular

[1] *Aleurodicus* (*Aleurodes*) *pulvinata* Maskell is not indicated in the table, and is referred to *Aleurodicus* on the authority of Cockerell (Psyche, v. 8, No. 266, p. 226). If a description of the adult stage of this species has been made, I have not been able to find it.

spots between forkings of vein. Vertex of head acute and margined with brownish-red, continuous with eyes of same color. Pupa-case very flat, subovate and with but little secretion of wax.....*cockerilli* n. sp. (3)

Wings banded with gray.

Length from head to tip of wings somewhat over 2 mm. Forewings with 5 broad transverse bands of gray and a longitudinal band extending from the outermost band to margin of wing, a little below the apex. On cephalic margin of wing the bands are mostly straight and equi-distant, but mostly enlarged about middle of wing. The third and fourth bands are joined together by inward prolongation of longitudinal band. Third band interrupted below its middle, and its lower part is joined to second band, of which it appears an oblique branch. The true prolongation of second band bends obliquely inward, and is joined at one point to the first band. The second band is also joined to first by a thin process in the region of the central nervure.....*ornatus* Cockerell (9)

Length, 1.66 mm.; forewing, 2.25 by 1.5 mm.; similar to *ornatus*, but markings of forewings of different pattern. There are four gray bands crossings the wings, of which only the third and fourth are joined by a longitudinal band. The basal band bends abruptly inward caudad of main nervure, which branches so near base of wing that there are practically 2 nervures, the first gray band failing in the angle between them but strong again before the second. Second band broad as far as the cephalic nervure; just beyond it interrupted broadly, but continued as a large nearly circular gray patch, the greater part of which is cephalad of caudal nervure, and passing thence as an oblique narrow band to the margin. Third band resembling second as far as cephalic nervure, which it meets at its fork; after that failing, but reappearing a little way down the lowest branch of the nervure, and thence passing downward, becoming very faint. Fourth band broad, passing across end of fork, bent inward, joining continuation of third band after the break, itself forking at its lower end. The curvure of fourth band leaves a white apical area in which there is a gray spot. There is also a gray spot at tip of second nervure.....*dugesi* Cockerell. (5)

Body of male about 2 mm. exclusive of forceps. Fore-wing slightly over 2 mm. long by about 1.33 mm. broad, white, with 2 very pale gray bands, the first crossing wing just before fork of median vein, but interrupted for a space below the vein. The second a dilute transverse cloud not far from apex of wing. Externally pupa-case appears as a large mass (5 to 10 mm. long) of snowy white cottony tufts, irregularly disposed, from which spring very long curved white waxen threads.....*mirabilis* Cockerell. (8)

1. Aleurodicus anonaæ Morgan.

Ent. Mo. Mag., Second Series—Vol. III (1892), p. 32. On *Anona muricata; A. squamosa, Ficus*, and *Richardia pacifica*, Demerara. Received by the Div. Ent., U. S. Dept. Agric., on *Anona*, from Pernambuco, Brazil, and on *Anona reticulata*, Port-of-Spain, Trinidad.

2. Aleurodicus (Aleurodes) asarumis Shimer.

"Whitish, farinose, downy, especially on the wings. Head, thorax, and abdomen pale yellowish-white. Wings laid flat on the back in repose, short and broadly rounded at the apex; near the extremity, where the strong central vein branches, a dark macula in the form of an obtuse angle, opening posteriorly toward the apex of the wing. The posterior wing has a similar but fainter spot. Antennæ six-

jointed, first thick, clavate. Eyes brown, two-parted. Tarsi long, exceeding two-thirds the tibiæ. I find these insects during the entire summer on the under side of *Asarum canadense* (wild ginger). In September I have seen them very numerous in all stages, the larva and pupa presenting the usual scale-like form of this family; at this time the under side of the leaf that has reared a good colony is covered with a white downy secretion. The imago when slightly disturbed flies away, acting not much like small Tineina, hence it may often be found on trees, etc., but I have observed the larva only on the above-named plant, and believe it to be entirely confined to it."

Mt. Carroll, Ill., August 24, 1867, Shimer. Trans. Am. Ent. Soc., Vol. I, p. 281. See also Insect Life, 1893, p. 219.

3. Aleurodicus cockerellii sp. (Plate VI, figures 59–62).

Pupa-case.—Size about 1.63 by 1.23 mm.; subovate in shape, smaller end cephalad. Color uniformly yellowish. There is but slight waxy exudation from dorsum, which is more or less mealy. No wax rods have been observed. Dried specimens separate easily from leaf, leaving usually a ring of white mealy wax of the size and shape of case; extending from the periphery inward are light lines of this mealy wax, more or less distinctly marking the position of the abdominal sutures of the case. Dorsum of pupa-case almost flat, but as seen under a hand lens is much wrinkled transversely in dried material. These folds or ridges occur mainly along the body segments, and posteriorly become much curved around the vasiform orifice. Under the microscope the abdominal segments are indistinct and scarcely elevated, except in the medio-dorsal line, where a slight rounded keel may be observed. Margin of case practically entire. Very slight furrows or thickenings extend mesad a short distance from margin of case, rather marking the margin into more or less distinct rectangular figures. Just within the margin all around is a series of very small disc like pores, usually one to each of these marginal rectangles. Dorsum void of well-developed setæ, except a pair just within the caudal margin; but there is a pair of small setæ at vasiform orifice, and very minute setæ occur here and there on the dorsum. The five or more pairs of large compound pores, so usual on dorsum of pupa-case of *Aleurodicus*, seem to be absent in this species, but very many minute transparent pores may be detected on dorsum under high power of microscope.

Vasiform orifice subcordate, somewhat longer than wide; cephalic margin straight; at caudal end there is a short, stout, spine-like protrusion. Operculum subrectangular, about half length of orifice; cephalic and caudal margins practically straight, lateral margins rounded; lateral and caudal margins thick; minutely setose. Lingula quite as long as orifice, very broad, and bearing distally two pairs of setæ, the smaller pair proximad; minutely setose.

Rudimentary legs and antennæ on ventral surface quite distinct.

Distal joint of legs with a straight and truncate spine. Antennæ usual, minutely ringed.

Adult ♀. Length, about 1.96 mm.; fore-wing, about 2.4 by 1.6 mm.; length of hind tibia, 0.8 mm.; length of hind tarsus, 0.56 mm.; length of front tarsus, 0.32 mm.; color, bright yellow, legs and antennæ paler; wings very broad, and rounded distally. Wings marked with more or less circular spots of brownish black. In fore-wings, along cephalic margin, are three spots about equidistant, and farther distad, on curve of wing, is a spot somewhat farther from the third spot than are two and three from each other. There is a spot on the margin of outer caudal curve of wing and three spots on the caudal margin, which, however, are not equidistant, as in the spots on cephalic margin. Within the area bounded by the distal fork of the vein are two spots, and within the area bounded caudad by the proximal branch are from three to five spots. In hind-wings there is a spot on outer cephalic margin, and on the outer caudal margin are two spots. There are two spots in the area bounded by the distal fork of vein, and likewise two spots in the area bounded caudad by the proximal branch of vein. Head as seen from above acute cephalad, and margined with deep reddish or brownish black, continuous with eyes which are of same color. Joint 1 of antennæ short, subcylindrical, distal end irregularly notched or toothed. Joint 2, thick, club-shaped, about three times longer than basal and bearing two or three setæ on outer lateral surface. Joint 3 quite long—quite twice the length of fourth. Distal joint short, terminating in a single seta.

Received by the Division of Entomology at Washington from Dr. F. Noack, Instituto Agronomico, Campinas, Estado de S. Paulo, Brazil, on leaves of a myrtaceous plant, March 30, 1898, and again from Dr. Noack, on same plant, June 14, 1898. The writer has also received specimens of this insect from Prof. T. D. A. Cockerell, to whom they had been sent by Dr. Noack. The adults are unique, in the genus *Aleurodicus*, from the more or less circular spots on the wings. Div. Ent., Nos. 8010 and 8115. Type pupa-case, 8010, described from nine specimens, and specimens on leaf, from Professor Cockerell. Type, adult ♀, 8115, described from two specimens.

4. **Aleurodicus (Aleurodes) cocois** Curtis.

Gard. Chron., 1846, p. 284. A good description by Riley and Howard, with figures, occurs in Insect Life, Vol. V (1893), p. 314. On cocoanut trees, in Barbados and Demerara; on guava, Isle of Trinidad; on guava, Caracas, Venezuela; on guava, Para, Brazil.

5. **Aleurodicus dugesii** Cockerell.

Can. Ent., vol. 28 (1896), p. 302. On *Hibiscus rosa-sinensis*, *Begonia*, and other plants, Guanajuato, Mexico.

6. **Aleurodicus iridescens** Cockerell.

Psyche, vol. 8, no. 266, p. 226.

7. **Aleurodicus minima** n. sp. (Plate VI, figures 63–67.)

Pupa-case.—Size about 1.17 by 0.71 mm., subelliptical, many specimens are somewhat narrowed cephalad. Case usually widest across region of second abdominal segment. Color yellowish, varying to brownish. Empty case semi-transparent, except for the irregular brown coloration on margin, and at the dorsal pores. Margins slightly crenulated, with very shallow indentures between the lateral wax tubes. There is no marginal rim. Just within the margin, all around, is a closely set row of short disk-like tubercles or papillæ, from which is produced a fringe of almost straight, tapering, glassy waxen rods from one-third to one-half as long as pupa-case is wide. On the more central dorsal region a light mealy waxen exudation may occur. Pupa-case slightly raised from surface of leaf by vertical fringe of wax, which usually remains attached to leaf on removal of dried specimens. On the dorsum, nearer the margin than center, is a row on each side of seven round and well-defined compound pores. Considered transversely, these occur in pairs; a pair on cephalic segment; a pair on metathorax; three pairs along the abdominal segments, and two pairs in the region latero-caudad of the vasiform orifice. The caudal pair is somewhat the largest, with the cephalic pair next in size; the rest are subequal. These pores, individually, consist of a cylindrical, brownish-colored rim with a central, white, rod-like structure. On cephalic margin of case is a pair of setæ and a pair on the caudo-lateral region, a seta on each side. There is a pair of small, tubercled setæ just within caudal margin. Around the margin, just within the submarginal series of papillæ, is a row of small tubercled setæ, usually from 24 to 28 in all.

Vasiform orifice elongate-cordate; about three-fourths as broad as long; cephalic margin straight, caudal end bluntly rounded. Operculum, subelliptical, cephalic margin straight, about one-third as long as orifice. Lingula usual, broad, extending quite to caudal end of orifice, bearing two pairs of setæ distally. On ventral surface, rudimentary feet and antennæ quite distinct.

Adult ♂.—Length, about 0.86 mm.; fore-wing, 1.1 by 0.52 mm.; length of hind tarsus, 0.21 mm.; length of hind tibia, 0.38 mm.; length of hind femur, 0.26 mm.; color, yellowish white, with dorsum of thorax brownish. Eyes reddish, undivided, though with a pronounced constriction. Joint 1 of antennæ short, not one-half the length of second. Joint 2, narrow at base, truncate at distal end, widest centrally. Joint 3 long, longer than remaining joints together, distal joint ending in an attenuated process, bearing a terminal seta. Anterior tarsus about three-fourths length of posterior. Distal tarsal joint of first pair legs two-thirds length of distal joint of mentum. Wings slightly clouded around margin and with a very dilute oblique transverse band centrally; at fork of distal branch of vein is a pronounced spot of brownish-black

coloration, otherwise wings without spots. Margins of wings and the veins somewhat yellowish. Genitalia quite short for this genus; valves short and stout.

Adult ♀.—Unknown.

This species approaches in some particulars quite close to Cockerell's *iridescens*, but it is much smaller, and the pupa-case differs in several particulars. It is quite similar also to Shimer's *asarumis*. His description is so meager that it will hardly be possible to locate his species unless, peradventure, the type has been preserved.

Specimens received by the Division of Entomology at Washington, January 28, 1889, on "Guayaba," from A. Busck, Bayamon, Puerto Rico. Mr. Pergande remarks that quite a large number of the insects (pupæ?) had been killed by a very curious fungus. Div. Ent., No. 8422. Pupa-case described from numerous specimens; adult ♂ from two specimens.

8. **Aleurodicus mirabilis** Cockerell.

Psyche, vol. 8, No. 266, p. 226; also Psyche, vol. 8, No. 277, p. 360. On a plant called "laurel," at Boca del Lestumacinta, Tabasco, Mexico; also on *Anona*, Minatitlan, Mexico.

9. **Aleurodicus ornatus** Cockerell.

Ent. Mo. Mag., 1893, p. 105. On Capsicum, Kingston, Jamaica.

10. **Aleurodicus (Aleurodes) pulvinata** Maskell.

Trans. N. Z. Inst., 1895, p. 439. On *Jatropa* sp., Trinidad.
Psyche, vol. 8, No. 266, p. 226.

EXPLANATION OF PLATE I.

Aleurodes abnormis.

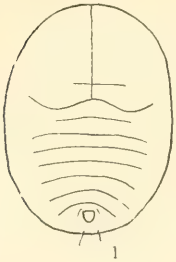
1. Pupa-case.
2. Diagram of cross section of pupa-case, to illustrate the downward and inward curved marginal rim.
3. Fore-wing of adult.

Aleurodes acaciæ.

4. Pupa-case.
5. Egg.
6. Vasiform orifice, operculum, and lingula of pupa-case.
7. Portion of marginal rim of pupa-case.

Aleurodes altissima.

8. Pupa-case.
9. Portion of margin of pupa-case.
10. Vasiform orifice, operculum, and lingula of pupa-case.
11. A compound pore, from dorsum of pupa-case.
12. Circle of pores, and rotate figure on dorsum of pupa-case.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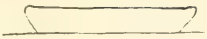
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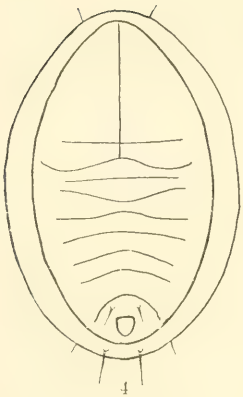
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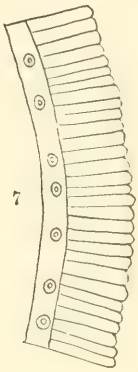
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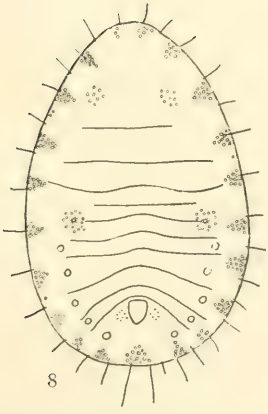
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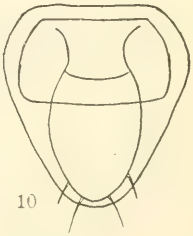
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ALEURODIDÆ—QUAINTANCE.

EXPLANATION OF PLATE II.

Aleurodes coronata.

13. Pupa-case.
14. Portion of margin of pupa-case.
15. Vasiform orifice of pupa-case.

Aleurodes fitchi.

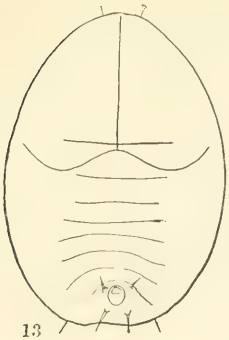
16. Pupa-case.
17. Fore-wing of adult.
18. Vasiform orifice, operculum, and lingula of pupa-case.
19. Portion of margin of pupa-case.

Aleurodes floridensis.

20. Pupa-case.
21. Portion of margin of pupa-case.
22. Vasiform orifice, operculum, and lingula of pupa-case.

Aleurodes inconspicua.

23. Pupa-case.
24. Vasiform orifice, operculum, and lingula of pupa-case.
25. Portion of margin of pupa-case.



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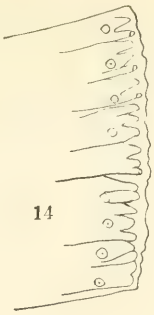

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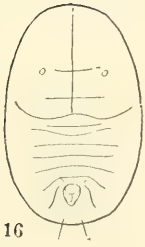

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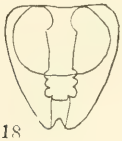

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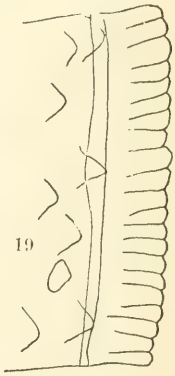

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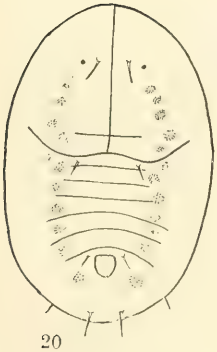

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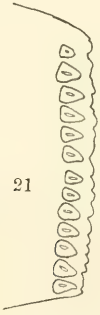

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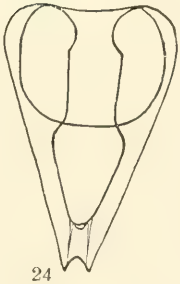

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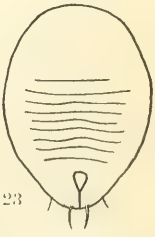

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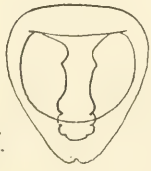

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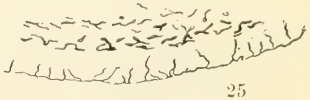

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A. L. Q. ad nat del.

ALEURODIDÆ—QUAINTANCE.

EXPLANATION OF PLATE III.

Aleurodes nephrolepidis.

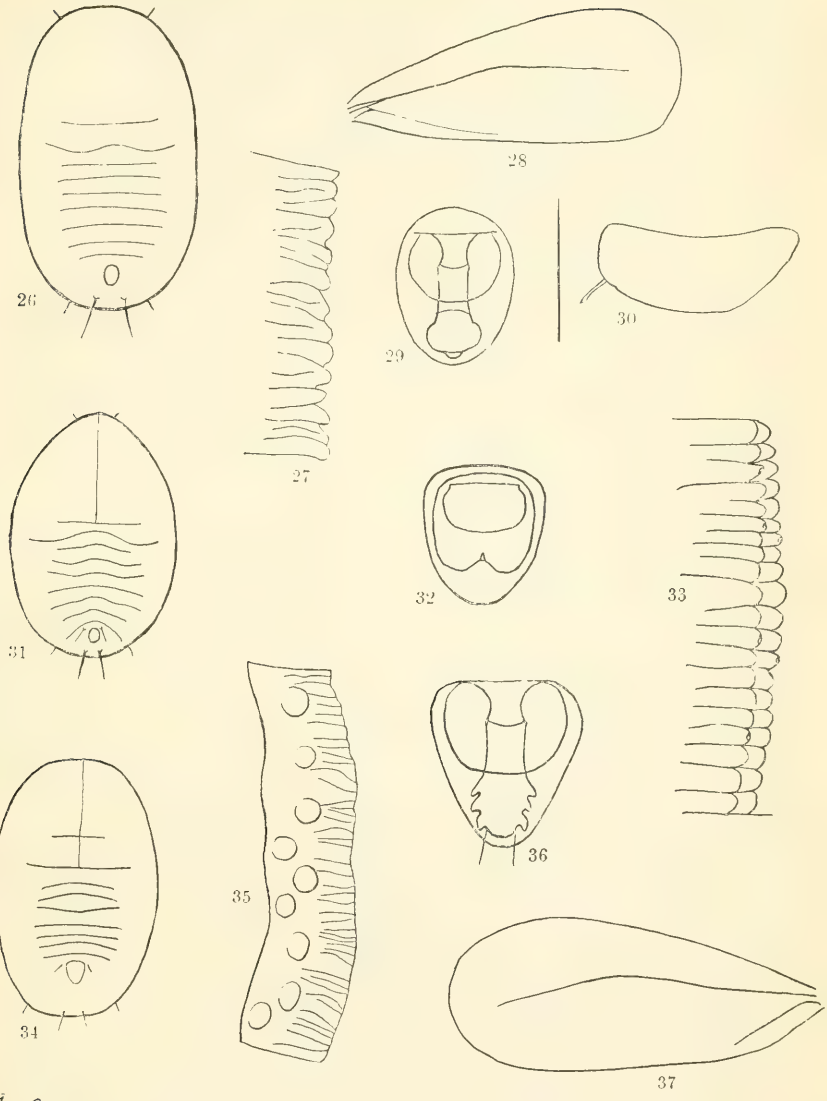
26. Pupa-case.
27. Portion of margin of pupa-case.
28. Fore-wing of adult.
29. Vasiform orifice, operculum, and lingula of pupa-case.
30. Egg.

Aleurodes plumosa.

31. Pupa-case.
32. Vasiform orifice, and operculum of pupa-case.
33. Portion of margin of pupa-case.

Aleurodes pergandei.

34. Pupa-case.
35. Portion of margin of pupa-case.
36. Vasiform orifice, operculum, and lingula of pupa-case.
37. Fore-wing of adult.



A. L. Q. ad nat del

ALEURODIDÆ—QUAINTANCE.

EXPLANATION OF PLATE IV.

Aleurodes perseæ.

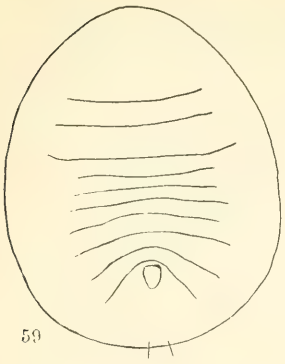
38. Pupa-case.
39. Vasiform orifice, operculum, and lingula of pupa-case.
40. Portion of margin of pupa-case.

Aleurodes quercus-aquaticæ.

41. Pupa-case.
42. Portion of margin of pupa-case.
43. Outline of vasiform orifice, with the surrounding fluted rim.
44. Fore-wing of adult.

Aleurodes spiræoides.

45. Pupa-case.
46. Portion of margin of pupa-case.
47. Vasiform orifice, operculum, and lingula of pupa-case.
48. Fore-wing of adult.
49. Hind-wing of adult.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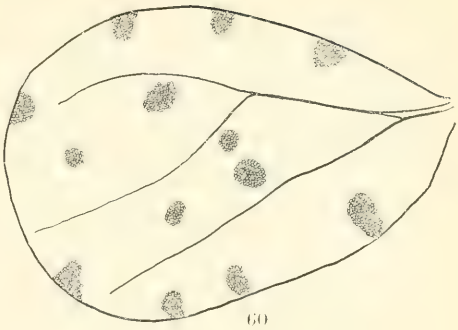
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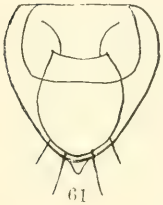
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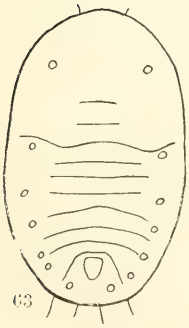
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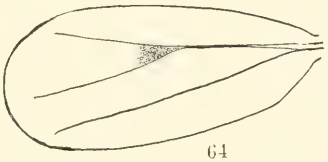
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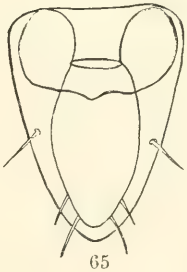
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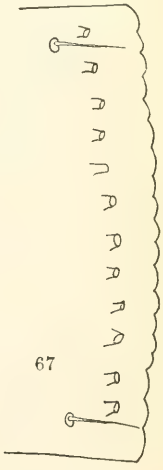
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A.L.Q ad nat del.

ALEURODIDÆ—QUAINTANCE.

EXPLANATION OF PLATE V.

Aleurodes tracheifer.

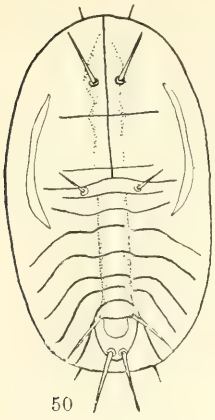
50. Pupa-case.
51. Portion of margin of pupa-case.
52. Vasiform orifice, operculum, and lingula of pupa-case with the surrounding rim, and spines.

Aleurodes variabilis.

53. Pupa-case.
54. Fore-wing of adult.
55. Vasiform orifice, operculum, and lingula of pupa-case.

Aleurodes vittata.

56. Pupa-case.
57. Vasiform orifice, operculum, and lingula of pupa-case.
58. Portion of margin of pupa-case.



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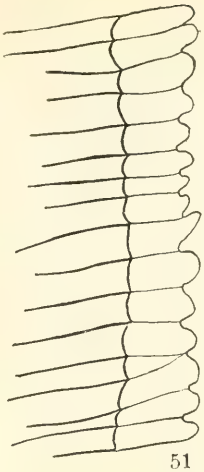

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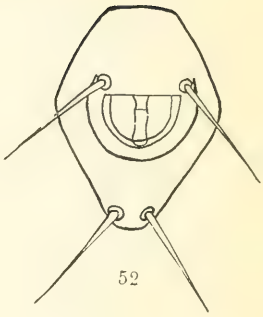

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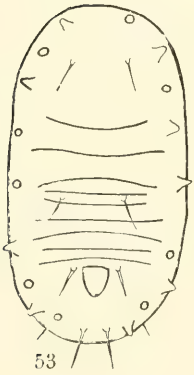

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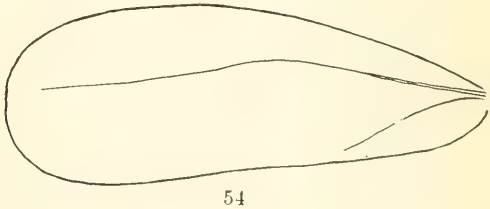

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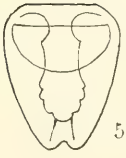

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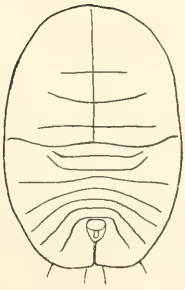

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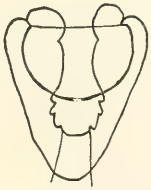

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A. L. Q. ad nat del.

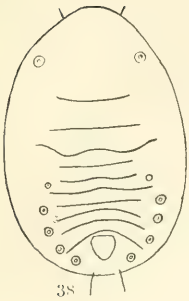
EXPLANATION OF PLATE VI.

Aleurodicus cockerelli.

59. Pupa-case.
60. Fore-wing of adult.
61. Vasiform orifice, operculum, and lingula of pupa-case.
62. Portion of margin of pupa-case.

Aleurodicus minima.

63. Pupa-case.
64. Fore-wing of adult.
65. Vasiform orifice, operculum, and lingula of pupa-case.
66. A compound pore from dorsum of pupa-case.
67. Portion of margin of pupa-case.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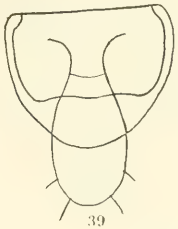
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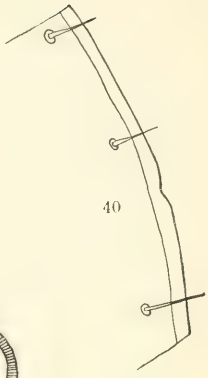
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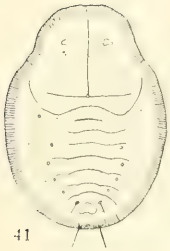
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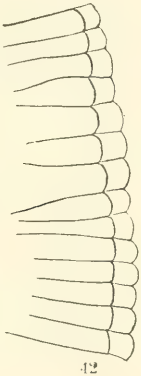
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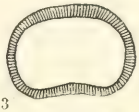
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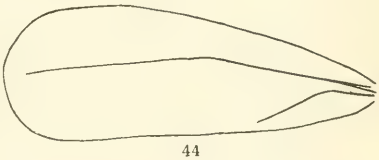
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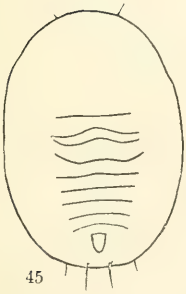
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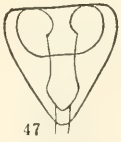
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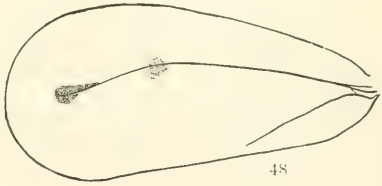
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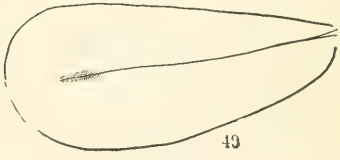
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ALEURODIDÆ—QUAINTANCE.

EXPLANATION OF PLATE VII.

68. *Aleurodes acaciæ.*
69. *Aleurodes coronata.*
70. *Aleurodes altissima.*
71. *Aleurodes fitchi.*

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ALEURODIDÆ—QUAINTANCE.

EXPLANATION OF PLATE VIII.

72. *Aleurodes pergandei.*
73. *Aleurodes tracheifer.*
74. *Aleurodes spiræoides.*

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ALEURODIDÆ—QUAINTANCE.

THE RED SPIDERS OF THE UNITED STATES.

(*Tetranychus* and *Stigmæus*.)

By Nathan Banks.

HISTORY.

The genus *Tetranychus* was established in 1832 by Dufour for a small mite found living gregariously on clumps of gorse. He noticed that there was a milky whitish irregular web or mesh of threads upon which crawled tiny red objects, which, by the aid of a glass, he discovered were mites. He kept specimens in a bottle, and saw them produce a similar web. Since then these creatures have been known as "spinning mites." Similar mites were known from the time of Linnæus, and one described by him as *Acarus telarius* is considered identical with Dufour's form. These spinning mites were found on a great variety of plants, and showed differences in size and color, which, coupled with their different habitat, led the naturalists of that day to consider these forms as separate species. Gradually, it was discovered that certain species were extremely variable in color, and occurred on more than one plant. This overthrew the old classification, and since then it has never been determined what was a species in this genus. The best two modern authorities working on the same (Italian) fauna reach quite different results. Certain forms of these mites have caused considerable injury to plants, especially in greenhouses, and from the red color of most of them, have been termed "red spiders." As some of the early accounts considered the common red species as *T. telarius* Linn., this name has been applied indiscriminately to all red spiders, both in Europe and

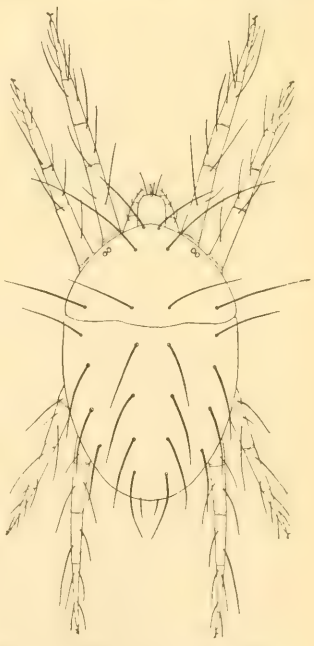

Fig. 1.—*Tetranychus bimaculatus*—enlarged (original).

this country. So it happens that throughout our economic literature there occur accounts of *Tetranychus telarius* without any consideration as to whether the form mentioned was identical with the European species of that name. The first break from this custom was made by Dr. Riley, who, in 1889, recognized that the form occurring on oranges was different from *T. telarius*. In 1893 Professor Harvey described a form found in greenhouses in Maine and New York as *T. bimaculatus*. With these two exceptions *Tetranychus telarius* is still considered responsible for all "red spider" damage. In 1877 Prof. A. Targioni Tozzetti, in a paper on the mouth and feet of *Tetranychus*, showed that the form known as *T. socius* differed from *T. telarius* in the nature of the tarsal claws. In the latter, as in many other forms, the claw is suddenly bent before the middle and the apical part four-cleft; in *T. socius* the claw is less curved and simple. Similar differences obtain in certain of our species, as will be noticed below. In Prof. A. Berlese's recent work, Acari Italiani, he draws attention to a hitherto unused character, namely, the small projections on the tip of the "thumb" of the palpus. These vary in number, size, and shape, and, I believe, form good characters for the discrimination of species.

STRUCTURE.

The mites are an order in the class Arachnida. In this order there have been various divisions, yet *Tetranychus* has always been kept in association with certain other well-known forms, as *Trombidium*, *Bdella*, *Eupodes*, *Erythræus*, etc. This association or group of forms has received various names, such as *Trombidida* and *Prostigmata*. With *Tetranychus* has been associated certain other genera to form a family *Tetranychidæ* the limits of which are uncertain, and according to Canestrini (Pros. Acarofauna Ital.) can not be defined. But the genus *Tetranychus* can be separated on fairly definite characters. They are spinning mites; the body is ovate, roughly oblong, or pyriform; clothed above with about 24 to 36 bristles, usually long, and arranged somewhat roughly in four rows. The legs are never much longer than the body, and the joints are never enlarged. The anterior third of the body shows a slight constriction, which marks the division of the body into cephalothorax and abdomen. On the underside there is no division, but if the natural division is vertical (which I think improbable) the third and fourth pairs of legs arise from the abdomen. The body is broadest at the base of the abdomen. The cephalothorax is somewhat semicircular in outline. On each side about half way and near the margin is an eye-spot, containing usually, possibly always, two ocelli. Some authors have figured but one ocellus each side. The fore part of the cephalothorax incloses the mouth-parts. Above, there is a plate about twice as long as broad, and

broader behind than in front; it can be retracted into the cephalothorax just below the dorsal surface. This plate is divided by a median line or sulcus; on each side below and toward the tip there arises a long and slender curved stylet. This plate appears to be formed by the union and flattening of the basal joints of the mandibles.

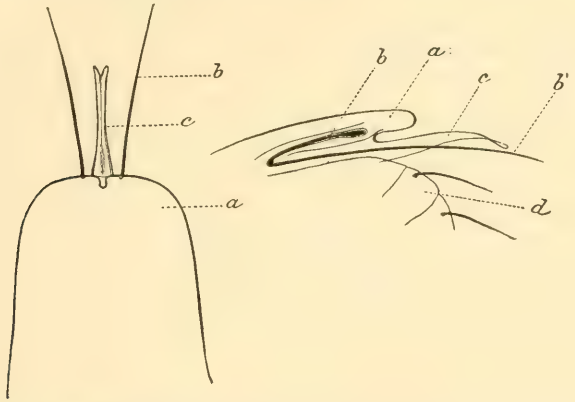

FIG. 2.—*Tetranychus:* mandibular plate, dorsal and lateral views: *a*, plate; *b*, stylet; *c*, spina; *d*, palpus—highly magnified (original).

Below this plate is a rather large and conical rostrum, from each side of the base of which arises a palpus, each composed of five joints. The penultimate joint ends in a large claw; the last or "thumb" projects little if any beyond this claw, and bears one or more projections or "fingers" on its tip or sides. In some species, perhaps all, the palpus of the male has a short, curved spine on the tip of the upper side of the third joint. The rostrum at tip has a cylindrical projection, rather enlarged at the end, consisting of a piece each side, which is possibly the maxilla. The opening between the two is the mouth. At the tip of the abdomen on the ventral surface is the anal opening, often showing from above at the tip of a median pointed projection. On the venter slightly in front of the anal orifice is the genital opening. In the female it is surrounded with variously curved striæ; in the male it is much less conspicuous—a simple slit inclosing a rather slender curved penis. The vulva in the various forms appears somewhat different, although on the same plan. But the difficulty of examin-

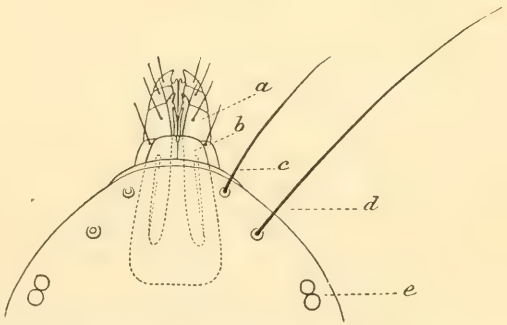

FIG. 3.—*Tetranychus:* cephalothorax from above: *a*, palpus; *b*, mandibular plate; *c*, frontal bristle; *d*, subfrontal bristle; *e*, eyes—highly magnified (original).

ing these organs in a large series of specimens as well as in the various species precludes the present possibility of using them for specific distinction. I am inclined to believe that there is some variation in the form of the vulva, due to the condition of the specimen. The lines and ridges are in a soft tissue, and so are liable to modification and distortion.

There are four pairs of legs in the adult; in the young, as in the young of most other mites: but three pairs are present. Each leg consists of at least six joints, a coxa, more or less anchylosed to the body; a small trochanter; a femur, the longest joint; a patella, about one-half the length of the femur; a tibia, slightly longer than the patella; a tarsus, longer than the tibia and tapering to a fine point. The tarsus, near its tip, has a division more or less distinct, the small terminal piece being called the onychium; from the tip of this arises the claw, which is usually cleft into four slender parts, whence the name of the genus—*Tetranychus* four-claw. The first pair of legs is the longest, though often scarcely longer than the fourth pair; the second and third pairs are plainly shorter than the other two and sub-

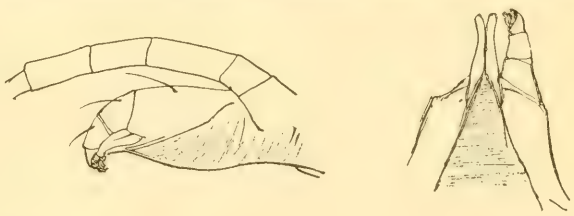

FIG. 4.—*Tetranychus:* mouth parts, lateral and ventral views—highly magnified (original).

equal in length. On the ventral surface the basal limits of the coxæ are not well defined, but the coxæ are rather widely separate.

The surface of the body is very finely and often regularly striate, mostly in a transverse manner. The hairs or bristles are minutely serrate, those on the anterior part of body curve forward, those on the posterior portion of body bend backward; the long ones on the legs appear to stand nearly erect in life, and doubtless have some sensory function.

There appears to be much uncertainty regarding the spinning apparatus, and an examination of a large number of specimens does not throw much light on the subject. Dujardin, Pagenstecher, and Donnadieu believed that the thread issued from the mouth or in its close vicinity. Dufour and Dugès assert that it comes from the anal end of the body. Claparède found some glands opening on the tips of the palpi which he considered as silk glands. The thread is not produced during the ordinary wanderings of the mite, but at certain times. When mites first attack a leaf there are only a few scattered threads lying close to the surface of the leaf, which are attached here and there

to the leaf and to the eggs. The mites walk about without using them. As the leaf curls by loss of juices the threads become more separated from the leaf, so that some mites are under and some on the web, which seems to be in their way. Since the thread seems to be of use at first in keeping the eggs in place, it may be that it issues from the genital opening at about the time of oviposition.

HABITS.

Attention is usually drawn to these mites when they become excessively numerous during a drought in summer. Little is known about the other portion of their lives. They are supposed to pass the winter in the adult condition under and among dead leaves; in the spring ascending trees and starting new colonies. It is quite probable that only females hibernate; if these females have not been fertilized the first eggs they lay produce only males, which when adult will pair with the females, and the latter will then lay eggs producing both sexes. Various observations have been made on the rapidity of their increase. The general results are that the female lays from five to ten eggs per day for a period of eight to twelve days; the eggs hatch in about two to seven days (three days is probably the most common period); the young at first have but six legs; after a few days they molt and have eight legs; two more molts occur a few days apart, and then they are adult.

FIG. 5.—*Tetranychus:* genital organs—highly magnified (original).

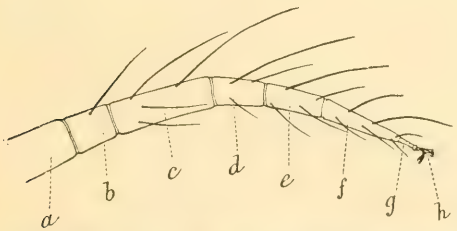

FIG. 6.—*Tetranychus:* leg, *a*, coxa; *b*, trochanter; *c*, femur; *d*, patella; *e*, tibia; *f*, tarsus; *g*, onychium; *h*, claw—much enlarged (original).

Their movements are ordinarily slow, but when disturbed they sometimes stir quite rapidly. For the greater part of the time they remain in one place sucking the juices from the leaf. But migration is probably not wholly dependent on food supply, since plants are found scantily infested in various parts and the mites are not abundant anywhere. Although they spin threads they have never been observed to hang by or climb up one. The thread is extremely fine and not perceptible to the unaided eye. Yet a web or mesh of threads is so dense as to form a tissue plainly visible at a considerable distance. The web is usually upon the under side of the leaf, attached here and

there to projecting hairs, veins, and the edges of the leaf. Many exuviæ of the mites are found entangled in this web, and certain authors think that the mites molt while on the web, but such is certainly not always the case with all species. The mites usually show a preference for the under side of the leaf, but in some cases they are more abundant on the upper side. Occasionally in the spring they attack the opening buds.

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Perkins, G. H.—Report of the Entomologist.—10th Ann. Rept. Vt. Agric. Exp. Sta., 1896–97 (1897), pp. 75–86, 1 plate.

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TETRANYCHIDÆ.

As previously indicated, this family includes a number of genera; only a few of them, however, are known as "red spiders." But two genera have been observed in material collected in this country as red spiders. These two genera are abundantly distinct in many points.

In *Tetranychus* the body is subpyriform, in *Stigmæus* elongate and subcylindric, in the former with many long, stiff bristles, in the latter provided with only a few short hairs.

Tetranychus Dufour. Ann. Sci. Nat., XXV, 274, (1832).
Distigmatus Donnadieu. Rech. Hist. Tetran., (1875).
Phytocoptes Donnadieu. Rech. Hist. Tetran., (1875).
Heteronychus Can. et Fanz. Acari Ital., (1877).
Oligonychus Berlese. Acari dann. piante coltiv., (1886).

The principal characters lie in the general shape of the body; clothed with bristles, with simple, moderate legs—with mandibles having the bases flattened and united in a retractile plate, with distal joints extremely long and slender, and with a palpus having the penultimate joint ending in a claw, while the last joint forms a "thumb" bearing one or more "fingers."

Our species as far as known may be tabulated as follows:

1. Bristles of body arise from prominent tubercles 2
   Bristles of body do not arise from tubercles 3
2. Legs of average length, apparently two claws at tip of each tarsus ..... *mytilaspidis*
   Legs very slender, one claw, four-cleft beyond the middle ..... *gracilipes*

3. Tarsus with but one claw, which is only slightly curved and simple, legs rather short 4
   Tarsus with but one claw, which is strongly bent near its middle and beyond is four-cleft 5
4. A plate or lamella at inner base of thumb, the thumb with several fine hairs on tip (often indistinct), mandibular plate emarginate at tip ..... *bicolor*
   No such plate or lamella, tip of thumb with three fingers ..... *modestus*
5. But one finger on tip of thumb, and one toward the base on the upper side 6
   Three fingers on tip of the thumb 7
6. The finger at tip of thumb is very stout, almost as broad at base as is the thumb at the tip, palpi rather short ..... *tumidus*
   The finger at tip of thumb is much more slender ..... *bimaculatus*
7. Seen in side view the lower finger appears the largest, not yellowish, with six dark spots ..... *telarius*
   Seen in side view the middle finger appears the largest 8
8. Yellowish, with six dark spots, on orange ..... *sexmaculatus*
   Not so marked 9
9. Mandibular plate tapers considerably toward the tip; on desert plants ..... *desertorum*
   Mandibular plate less tapering; on cotton ..... *gloveri*

Tetranychus mytilaspidis Riley.

Penthalodes mytilaspidis Riley.—Hubbard, Orange Insects (1885), p. 216.

Rather larger than most species; body quite broad behind; bristles stout, each arising from a prominent tubercle; the subfrontal pair are very long, more than twice (nearly three times) longer than frontal pair and farther apart; they have the usual arrangement. The palpi are short and stout, the last joint very short, with a short thumb, upon which is a rather clavate finger, a smaller finger near base on the upper side, and a hair at the upper tip. The mandibular plate is broad, broadly rounded at tip, scarcely emarginate in the middle, with the stylet beneath. Legs rather short, bristles not especially long; the femur of leg I is longer than usual, fully twice the length of the patella; tibia I only a little longer than patella. The tarsus terminates in a claw which, seen from below, appears simple; seen from the side, shows two claws, the principal one but little curved, the other much more curved and arising (apparently) from below and near the middle of the principal one; these two claws appear to lie in the same plane.

FIG. 7.—*Tetranychus mytilaspidis*: claws, much enlarged (original).

Color blood red, dark spots each side; legs paler red; bristles pale reddish; eggs globular, reddish.

This species is a true *Tetranychus* and not a *Penthalodes*. It is closely related to the European *T. pilosus* C. & F. Specimens come from several parts of Florida on orange and on *Limonium trifoliatum*, also on peach from Marshallville, Ga. Riley states that there are three claws, and Berlese figures the European *T. pilosus* with the lower claw cleft; but on careful observation I can not discern any division to the lower claw in the many specimens examined, some of which are evidently Riley's types. Little is known of the habits of this species.

Hubbard believed that it fed on scale insects or their eggs. It is undoubtedly a *Tetranychus*, and probably feeds, like the other species of the genus, on plant juices. Hubbard says (Orange Insects, p. 83): "The eggs are sherry-brown color, quite large and globular, and are usually deposited singly upon the leaf or strung like amber beads upon strands of spider's silk, which harbor the mites and their young."

Tetranychus gracilipes n. sp.

Body with the usual bristles stouter than in most of the species, the lateral ones extending more outwardly than usual; all are situated on the elevated tubercles. Body a little broader than usual. The beak is more elongate than in any other species, which is also the case with the palpi, which are rather closely applied to the beak, the last joint very slender, ending in a stout claw; thumb stout, truncate, with one finger. The legs are slender, especially the first pair, which is much longer than the body; femur I fully five times as long as broad; on the joints above, toward the tip, is a stout bristle-like spine; very few other bristles on legs except close to the tip of tarsus. The claw is at first simple, strongly bent near the middle, and then four cleft (similar to *T. bimaculatus*). The mandibular plate is longer and more slender than usual, tapering slightly to the tip, where it is broadly rounded, and apparently without a median notch.

Phœnix, Ariz. Prof. Cockerell found this on the leaves of a species of Sphæralcea. The leaf bears stellate hairs, to which the mite has a deceptive resemblance.

Tetranychus bicolor Banks.

Tetranychus bicolor Banks.—Trans. Amer. Ent. Soc., 1894, p. 218.

Body mostly red, often pale in front, and with some dark marks each side on abdomen; legs pale yellowish; eyes red; bristles white. Body (♀) rather broader than usual, the legs plainly shorter than in most of the species; cephalothorax and abdomen with bristles in the usual positions and of ordinary length; mandibular plate broad, scarcely tapering toward tip, which is broadly rounded and usually distinctly emarginate in the middle. Palpi short, male with a tooth above on inner tip of tibia; the thumb has several fine hairs on its tip (but indistinct); the claw is thick and much curved, and at inner base of thumb there is a thin plate or lamella (not seen in any other species). The tarsus is short; there is but one claw, which is long, curved only toward the tip, and not cleft.

FIG. 8.—*Tetranychus bicolor*: claws, enlarged (original).

The typical specimens were found on the upper side of chestnut and oak leaves in the woods near Sea Cliff, N. Y. Other specimens have been seen from oak at Washington, D. C., and from Geneva, N. Y., on a Norway spruce hedge.

Tetranychus modestus n. sp.

Head, palpi, and legs are brownish, the body yellowish, with quite large blackish irregular spots across middle of thorax, a large lateral spot in region of last pair of legs, and a broad irregular border around end of body. Body rather more elongate than usual; bristles in the usual arrangement; legs short; femur I fully twice as long as broad; tibia I only a trifle longer than patella I; tarsus short, ends in a long, simple claw, curved only toward tip, in all respects like that of *T. bicolor*. Mandibular plate of moderate length, not much narrowed toward tip, which is broadly rounded. Palpi short, thumb not as long as claw, with three nearly equal fingers on the tip; there is no plate or lamella. On each side of the anal opening there is a pair of fine hairs.

Found in August at Washington, D. C., causing a rust-like appearance on the blades of corn. Closely allied to the preceding, but distinct by characters of palpi.

Tetranychus tumidus n. sp.

Dark red and somewhat pruinose, marked across the thorax with a dusky band, terminating each side in a rather large dusky spot, a similar spot on each side near end of body; in some specimens there is an additional spot each side between the two; legs and mouth parts pale reddish. Young specimens are paler, with spots more distinct and confluent. Eggs are pale red. Body moderately broad; bristles rather longer than usual, quite stout, all in the usual arrangement, subfrontal pair not twice as long as the frontal pair. Palpi of average length, thumb is short and stout, on its tip is a large short cylindrical finger whose base is not much smaller than the tip of thumb, at the inner upper corner is a short hair, and on the upper side near base is a slender finger. Mandibular plate about twice as long as broad, narrowed toward tip, the sides before tip slightly concave, broadly rounded at tip, with a small yet distinct emargination in the middle. Legs moderate; femur I fully twice as long as broad; tibia I plainly longer than patella; tarsus of moderate length, terminating in a claw which is strongly bent near middle and four-cleft beyond.

FIG. 9.—*Tetranychus tumidus*: palpus—enlarged (original).

Collected at Eustis, Fla., on the leaves of water-hyacinth, by H. J. Webber. It is closely allied to *T. bimaculatus* Harv., but distinguished by the very large finger on the tip of thumb.

Tetranychus bimaculatus Harvey.

Tetranychus bimaculatus Harvey.—Ann. Rept. Me. Agric. Exp. Sta. f. 1892 (1893), p. 133, Pl. III.

There are several styles of coloration, one is pale greenish yellow, with a large group of blackish dots each side on base of abdomen, sometimes a median group of dots; another style is dark crimson red, with black spots along each side of the body; legs, and hairs pale red-

dish, almost colorless. Body broadest at shoulders, tapering behind; bristles long and fine, in the usual arrangement, subfrontal pair not twice as long as frontal pair. Thumb of palpus rather long; on its tip is a cylindrical finger; on its upper corner is a hair, and on the upper side toward base is a small finger; in male above on inner tip of tibia of palpus is a spine or spur. Mandibular plate about twice as long as broad, tapering forward, broadly rounded at tip, with a small although distinct notch in the middle. Legs of moderate length, femur I fully twice as long as broad, tibia a trifle longer than patella, tarsus rather slender, terminating in a claw which is suddenly and strongly bent near the middle and four-cleft beyond.

FIG. 10.—*Tetranychus bimaculatus:* palpus—enlarged (original).

It is quite probable that this species is the one called by Boisduval (Entom. Horticole, p. 84) *Tetranychus cucumeris*, but the descriptions of that author in this genus are useless for identification. Quite possibly several of his names apply to this species. The forms found in the greenhouse do not appear to differ from those on garden vegetables and horticultural plants. It appears to be abundant all through the Eastern States and in several localities in the West. Specimens have been studied from Orono, Me., on various greenhouse plants; from Washington, D. C., on violets in greenhouse, on peach (curling the leaves), on *Datura*, on squash, on corn, and on strawberry; from Punta Gorda and Key Largo, Fla., on eggplant; on watermelon from Eustis, Fla.; on beans at Auburn, Ala.; and on roses from Weiser, Idaho. Professor Harvey records it from greenhouses in Ithaca, N. Y., New York City, and Westgrove, Pa.

The color and size are extremely variable. Yet in a lot from one plant and one region the adults are usually of one coloration and one size. Other lots from other localities have a much different appearance, but when mounted and examined do not disclose any structural difference. The specimens from Florida and those on *Datura* and violets from Washington, D. C., are red; those from Orono, Me., on squash and peaches from the District of Columbia, and on rose from Idaho are greenish, more or less marked with dark. The specimens from squash and *Datura* had made a considerable amount of web, much more than those on greenhouse plants.

FIG. 11.—*Tetranychus bimaculatus:* claws—enlarged (original).

This species has, more than any other, stood for the "red spider," *Tetranychus telarius*. Harvey remarks that specimens sent to him as the *genuine* "red spider" did not differ structurally from his species.

Tetranychus telarius Linn.

Acarus telarius Linn.—Fn. Suec., 481, No. 1974. (1761).
Tetranychus lintearius Dufour.—Ann. Sci. Nat., XXV, p. 276.

Color variable, often yellowish green, with black spots at sides of body, and sometimes at tip; legs pale; eyes red. Body rather broad in ♀, considerably tapering behind in the ♂. Bristles in the usual arrangement, the frontal and subfrontal pair as near the front margin as in other species (Berlese figures them much farther back), subfrontal pair twice as long as frontal. The palpi are quite prominent, the male has a spur above on tip of the tibia, the thumb bears on its tip three fingers; seen from the side the lower one is plainly larger than the others—those nearer the claw. The mandibular plate is about twice as long as broad, not much tapering toward tip, broadly rounded at tip, and with a faint median notch; the stylet is split nearly to plate. The legs are moderately long; femur I over twice as long as broad; tibia I plainly longer than patella I; tarsus quite long, ending in a claw strongly bent near middle and four-cleft beyond. I am not certain that this is the European species, but it has the characters of *T. telarius*, and does not differ, so far as I can see, from a specimen of *T. telarius* from Italy. The legs are a trifle more slender than in our other species. Specimens have been studied from Melrose Highlands, Middlesex County, Mass., on ash; from Waterville, N. Y., on hops; and from Fort Collins, Colo., on maple. Apparently it is not a very common species with us.

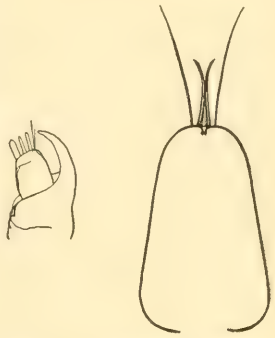

FIG. 12.—*Tetranychus telarius:* palpus and mandibular plate—enlarged (original).

Tetranychus sexmaculatus Riley.

Tetranychus sexmaculatus Riley.—Insect Life, Vol. II, p. 225.

Pale greenish-yellow, with six usually large dusky patches above, three on each side; legs and palpi pale. Palpi of moderate length; in male with a spur above on inner tip of tibia. The thumb is quite stout and bears on its tip three fingers, of which the middle one (seen from the side) is the largest. Mandibular plate rather slender, narrowed toward tip, which is broadly rounded, scarcely a trace of the median notch; bristles of body in the usual arrangement, the subfrontal pair scarcely twice as long as the frontal pair. Legs rather shorter than in *T. telarius*, the tibia I plainly longer than patella I; tarsus I shorter than usual, the claw strongly bent near middle and four-cleft beyond.

FIG. 13.—*Tetranychus sexmaculatus:* palpus—enlarged (original).

Specimens from various parts of Florida on orange, and some marked San Diego, Cal., on orange. This species appears to be smaller

than the other species of this group. It has at times been extremely abundant and an orange pest of much importance. An article on the species from an economic view is found in the Report of the Entomologist for 1889. They occur on the under surface of the leaves; the eggs are colorless or pale greenish-yellow

Tetranychus desertorum n. sp.

Dark red, with black spots along each side, and a central spot before the middle; legs pale. Body quite broad, with the usual bristles, the frontal pair about one-half as long as the subfrontal. The palpi are longer than usual; there is a spur on the tibia of male as usual; the thumb not as long as claw and with three slender fingers on the tip, the middle one (seen from the side) is the largest. The mandibular plate is long and slender, narrowed toward tip; at middle of tip a small but distinct deep notch; stylet below the plate appears to be cleft only for a short distance. The legs are quite stout, the femur I more than twice as long as broad; tibia I plainly longer than patella I; tarsus slender, ending in a claw, which is strongly bent near middle and four-cleft beyond.

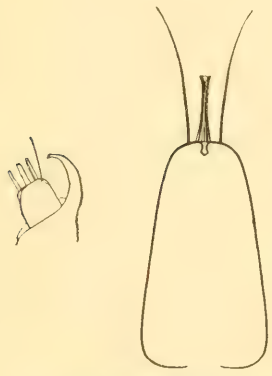

FIG. 14.—*Tetranychus desertorum:* palpus and mandibular plate—enlarged (original).

Specimens come from Mesilla Park, N. Mex., on *Larrea tridentata* and *Phacelia crenulata.* It is closely allied to the other species of this group, but the plate is more tapering than usual.

Tetranychus gloveri n. sp.

Red, with irregular dark confluent spots each side of body; legs yellowish. The body, though broad at the shoulders, tapers behind even in the female; bristles long and fine, the subfrontal pair more than twice the length of the frontal pair; all in the usual arrangement. The palpi are of average length, the thumb not so long as claw; on its tip are three fingers, the median one (seen from the side) plainly larger than the others. The mandibular plate is rather broad, its sides concave near the tip, and almost truncate, sometimes apparently broadly, though not deeply, emarginate; the median notch is scarcely visible. The legs are quite slender, femur I more than twice as long as broad; tibia I plainly longer than patella I; tarsus quite long, ending in a claw, which is strongly bent near its middle and four-cleft beyond.

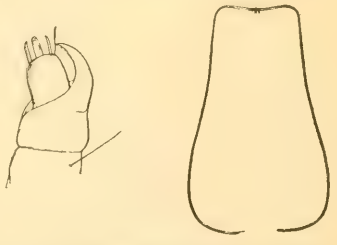

FIG. 15.—*Tetranychus gloveri:* palpus and mandibular plate—enlarged (original).

This species was figured by Glover in his Cotton Insects, and has been treated recently by Professor Morgan. Specimens have been examined from Baton Rouge, La.

Stigmæus Koch.—Uebersicht des Arachnidensystems, III, p. 53, 1842.

This genus differs much from Tetranychus in structure, but is closely allied in habits, the species living in colonies on leaves. The anterior and posterior pairs of legs are more widely separated than in Tetranychus; the body is more elongate and is usually more or less constricted near the middle; there are no rows of long bristles above; the tarsus ends in two equal claws, which in our species are deeply cleft. The mandibles in our species appear to be extremely long and styliform. The palpi seems to be simple, the last joint very slender. But one species has been observed in our country.

Stigmæus floridanus n. sp.

Body elongate, more than twice as large as broad, blunt-pointed at each end, constricted somewhat before the middle, the posterior part rather broader than the anterior, constricted slightly between the III and IV legs, four short curved bristles near apex, one on each anterior side of the posterior part and one on each side near the apical third of the anterior part. The legs are short and stout, scarcely as long as the width of body, the anterior pairs rather longer than the hind pairs; the tarsus ends in a pair of double claws, the outer branch longer and less curved than the inner branch.

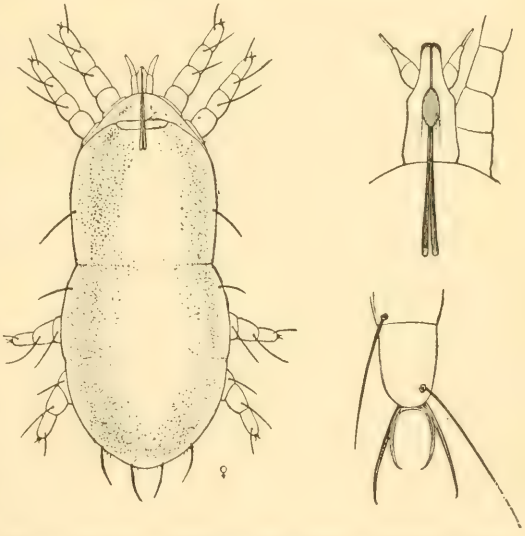

FIG. 16.—*Stigmæus floridanus:* mite, mouth parts, and claws—enlarged (original).

Living in colonies upon the bases of the imbricated leaves of the pineapple in Florida. A species of considerable economic importance owing to the fact that its punctures give certain destructive fungi access to the tissue of the leaf. In Australia Mr. H. Tryon has recorded a quite different mite affecting the pineapples in that colony. He claims that it often carries the spores of the fungous disease. He calls the mite *Tarsonemus ananas.*[1] Professor Rolfs has published[2] on the habits of this *Stigmæus* and the damage it leads to in Florida.

[1] Queensland Agric. Jour., 3 (1898), No. 6, pp. 458–467.

[2] Bul. No. 50, Fla. Agric. Exp. Sta., May, 1899.

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TECHNICAL SERIES, No. 9.

U. S. DEPARTMENT OF AGRICULTURE,

DIVISION OF ENTOMOLOGY.

THE LIFE-HISTORY

OF

TWO SPECIES OF PLANT-LICE

INHABITING BOTH THE WITCH-HAZEL AND BIRCH.

BY

THEO. PERGANDE,

ASSISTANT ENTOMOLOGIST.

PREPARED UNDER THE DIRECTION OF THE ENTOMOLOGIST.

WASHINGTON:

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Artist: Miss L. Sullivan.

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LETTER OF TRANSMITTAL.

U. S. Department of Agriculture,
Division of Entomology,
Washington, D. C., July 16, 1901.

Sir: I have the honor to transmit herewith the manuscript of a short but full paper entitled "Life history of two species of plant-lice inhabiting both the witch-hazel and birch," by Theodore Pergande, an assistant entomologist in this Division. I recommend that this paper be published as Technical Series No. 9. As explained in the letters transmitting earlier bulletins of this series, papers of this character, while only indirectly of interest to farmers, fruit-growers, and foresters, are of especial value to economic entomologists who are engaged in making practical applications of scientific entomology. In the present case plant-lice form a group of insects which are very destructive, economically considered. Their life histories are very remarkable and little understood. This is especially the case with those forms (and they are many) which have alternate food plants. The practical value of this kind of work was admirably illustrated in the investigation of the hop plant-louse, carried on under this Division some years since. In the discovery of the alternation of the food plants and the exact details of the life history was found a suggestion for an easy and practical remedy. The present paper well illustrates the remarkable phenomena which are to be ascertained in this group of insects and will be a guide to methods of investigation and to the results to be expected from the study of forms of greater economic importance, although one species here considered has in fact been known to kill young birch trees.

Respectfully,

L. O. Howard,
Entomologist.

Hon. James Wilson,
Secretary of Agriculture.

Smithsonian Inst.
170854
Natl. Mus.

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THE LIFE HISTORY OF TWO SPECIES OF PLANT-LICE, INHABITING BOTH THE WITCH-HAZEL AND BIRCH.

INTRODUCTION.

The study of the life history of the Aphididæ or plant-lice, in connection with their peculiar and frequently destructive habits as well as the remarkable traits of many of the species, has offered a most fascinating field for research and study to many naturalists, and their labors have brought to light numerous interesting facts regarding the habits and economy of various species. Much is still to be learned concerning the annual migrations and the intermediate habits and changes of the majority of our *Pemphigini*, the architects of galls or excrescences on the leaves and other portions of certain trees and shrubs, which they desert, at the opportune time, to vanish completely from sight. These migrations and sudden disappearances of the gall-makers leave the observer in doubt as to the whereabouts of the connecting links of the fleeting migrants, of which very few have thus far been discovered. During autumn and early winter the return migrants make their appearance, as suddenly and mysteriously as the spring migrants disappear, without bearing a clue as to their former habitations. This is for the purpose of restocking their original host plants with their eggs, to enable the species to commence a new cycle of existence the following spring.

Interesting as the life history of all these insects is, there are few or none among them which have a more remarkable or a more diversified cycle of existence than two species belonging to the genera *Hormaphis* and *Hamamelistes*, both of which, alternately, inhabit the witch-hazel, *Hamamelis virginica*, and the birch, *Betula nigra*. The study of the life history of these, after numerous failures and disappointments, covering a space of nearly twenty-two years of patient labor, the writer has been fortunate to bring to a successful conclusion.

The drawings were all made by Miss L. Sullivan under the writer's supervision.

HORMAPHIS HAMAMELIDIS Fitch.

The synonymy of the oldest of the two species, as it will now stand, is:

Hormaphis hamamelidis Fitch.
Byrsocrypta hamamelidis Fitch, N. Y. Cat. of Hom. Insects, 1851, p. 69.
Hormaphis hamamelidis Osten Sacken, Stett. Ent. Zeitung, 1861, p. 422.
Hormaphis hamamelidis Walsh, Proc. Ent. Soc. Philad., VI, 1866–67, p. 281.
Hamamelistes cornu Shimer, Trans. Am. Ent. Soc., I, 1867, p. 283.
Hormaphis hamamelidis Thomas, Trans. Ill. State Hort. Soc., 1876–77, p. 199.

The earliest, a rather brief record and description of this interesting Aphid, was published by Dr. Asa Fitch in 1851, in his "Catalogue of the Homopterous Insects of the State of New York," under the name of *Byrsocrypta hamamelidis*. Ten years later it was redescribed by Baron von Osten Sacken in the Stettiner Entomologische Zeitung (p. 422, 1861), under the generic name of *Hormaphis*, using the identical specific name adopted by Fitch, though not being aware of its having been described by Fitch under the same name, and erecting for it a new genus. A translation of this description, by B. D. Walsh, will be found in the Proceedings of the Entomological Society of Philadelphia, 1866–67 (p. 281). In 1867 it was again described by Dr. Henry Shimer, in the Transactions of the American Entomological Society of Philadelphia (vol. 1, p. 283), under the name of *Hamamelistes cornu*, with a rather full description of the gall and its architects. Excepting a short description of the gall and the winged insect, by Prof. Cyrus Thomas, in the Transactions of the Illinois State Horticultural Society for 1876, published in 1877 (p. 199), nothing additional regarding the history of this interesting species has been published.

The writer's observations regarding this species were begun at Washington, D. C., in the spring of 1878, and were continued with varying success until the end of 1899, when they reached a successful termination.

As with other gall-producing plant-lice, the study of the galls and their architects is comparatively easy, but, with the departure of the winged migrants, continuous observations are suddenly interrupted and the track lost, leaving no trace as to the whereabouts of the intermediate generations. Migration from the host plant takes place generally during spring or summer, the return migrants making their reappearance from early in September till late in the fall, to restock their host with eggs.

What becomes of this particular species during the intervening time after leaving its gall remained a profound mystery to the writer for many years, notwithstanding continuous efforts to solve the problem.

Accidentally, while on a collecting trip near Tacoma, D. C., in September, 1890, the writer observed a peculiar Aphid inhabiting the under side of the leaves of a small shrub of *Betula nigra*, but failed at that time to recognize it as the missing link of *Hormaphis*. During the following seven years nothing additional was discovered to cause me to continue observations, this being due in a great measure to the destruction of large numbers of witch-hazel bushes and young birches, and the consequent scarcity of galls in the woods surrounding the city of Washington. Fortunately, however, I discovered in September, 1897, a number of witch-hazel trees and bushes, as well as young birches, in a narrow and protected valley near the edge of a small creek at Cabin John Bridge, Md., where I found numerous old and

dry galls on the leaves of the witch-hazel. Here I began again my search for the evading generations of this species, and in examining the leaves of birches rediscovered on many of them the same peculiar Aphid which had previously been found at Tacoma. It was in various stages of development, including the winged migrants, which proved, after a thorough examination and comparison with the spring migrants of the witch-hazel, to be identical with *Hormaphis hamamelidis*. To be sure of no mistake an examination was made of the leaves of witch-hazels near the birches with the result that the underside of numerous leaves was found to be almost completely covered with larvæ of various stages, and among them numerous specimens of the migrants from birch, actively engaged depositing their progeny, which later on proved to be the sexual generation. This settled the previously obscure question as to the secondary host of the intermediate generations, and enabled me to continue and to complete my protracted observations of the life history of this remarkable little species and the strange transformations it undergoes on the birches, which will be recorded in the following pages.

HORMAPHIS HAMAMELIDIS Fitch.

Gall (Fig. 1).—The more or less rapid development of the galls produced by this species on the leaves of the witch-hazel depends entirely on the advancement or retardation of the season. In the latitude of Washington, D. C., they usually start about the middle of April, attaining their full growth and development toward the end of May. To be in time and ready for the duty assigned to them by nature, the young stem mothers hatch about a week or more in advance of the appearance of the young leaves, when they frequently congregate in considerable numbers on the still closed buds, patiently awaiting their bursting. During this critical period many of them perish, either for want of food or from the inclemency of the weather. The survivors settle at once on the underside of the tender and unfolding leaves, generally along the midrib or the lateral veins, and insert at once their sucking bristles into the tender substance of the young leaf. The presence of the young gall-maker soon becomes apparent on the upper side of the leaf by a pale yellowish-green discoloration, and within a few days the first symptoms of the growth of the new gall are observable in a small, blister-like swelling on the upper side and a corresponding depression beneath. From now on the development of the new gall is quite rapid, in order to keep pace with the growth of the leaf, so that at the beginning of May they have become quite convex or slightly conical above with the underside almost closed and protected by numbers of rather stiff, white, and radiating hairs to prevent the entrance of enemies. The color of these young galls, above and below, is of a greenish yellow, with the most elevated portion of a more or less pronounced vinous shade and surrounded

at base with a purplish or vinous ring, which is also more or less distinct on the underside. By the middle of May the galls are about two-thirds grown, showing the peculiar conical formation clearly and reaching full development toward the end of May, when they measure from 10 to 12^{mm} in length by 4 or 5^{mm} in diameter at base. They are obliquely conical, or of the shape of a dog's tooth, and somewhat constricted at base, the underside forming an elevated and rather stout rim around the more or less circular opening which is densely covered with a pale pubescence. The opening has by this time become large enough to allow the migrants to escape. They are now of a firm, leather-like consistency and of a uniform pale yellowish-green or greenish-yellow color. If not numerous, as in some years, there is generally but one or at most two galls on a leaf, whereas in favorable years there may be from two to eight or more galls on a single leaf, which then becomes more or less dwarfed and much distorted. These galls, even after their architects have departed, remain fresh and succulent for a considerable length of time, but gradually turn brown and dry up.

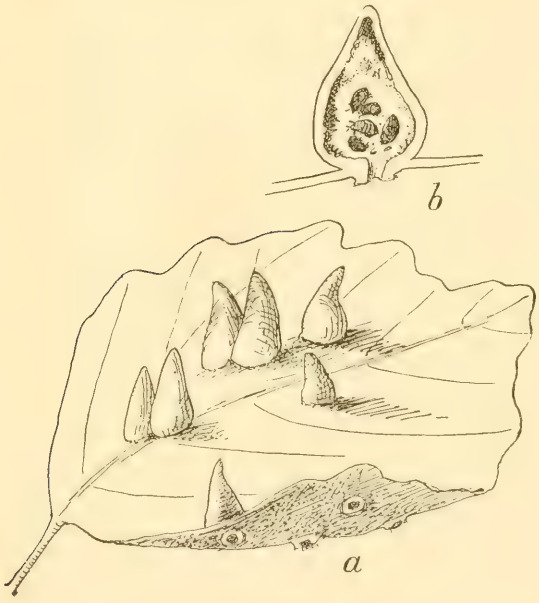


FIG. 1.—*Hormaphis hamamelidis*: *a*, galls, natural size; *b*, section of gall—much enlarged (original).

Winter egg.—The winter eggs of this Aphid, as in some other species of plant-lice inhabiting trees and shrubs, are deposited on the branches and twigs, especially those bearing the leaves, and generally around or near the base of the buds or near the scars left after the dropping of the leaves in October, or as late as any of the leaves bearing the sexed generation remain on the shrubs. The eggs resemble greatly those of *Aphis mali*, though they are considerably smaller, and measure about 0.2^{mm} in length. They are of a slightly pyriform shape, bluntly pointed at the posterior end and highly polished, being at first yellowish or orange but changing gradually to a deep black.

FIRST GENERATION.

Stem-mother, first stage (Fig. 2).—The young stem-mother on hatching is but slightly larger than the egg, and makes her appearance

about the middle of April, generally about a week or so in advance of the appearance of the young leaves, during which time they congregate on the buds, on some of which I observed as many as 24 larvæ. Many of them doubtless perish before the leaves burst forth. They are of a dull black color, covered with a delicate film of a slightly bluish secretion. The eyes are dark purplish and the antennæ and legs blackish. They are provided with short, stout, and truncate dorsal and lateral secretory tubercles or pores, of which there are about 18 to 20 on the upper surface of the head, 2 medio-dorsal groups of 6 to 8 on the prothorax, a group of 4 to 6 pores or tubercles each side of the median line of the meso- and metathorax, and 1 or 2 pores each side of the median line on the abdominal segments. There are also about 8 pairs of tubercles along the front margin of the head, half of them ventro-lateral, 5 or 6 each side of the thoracic, and 2 each side of the abdominal segments, with an equal number on the ventral side near the lateral margin which, when the insect is living, can not be seen from above. From each of these pores or tubercles issues a rather stout and straight, or slightly curved, transparent and iridescent white and truncated waxy rod, which gives to the insect a rather bristly, though pretty, appearance.

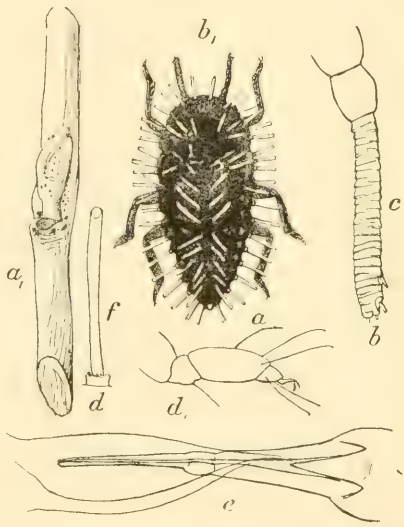


FIG. 2.—*Hormaphis hamamelidis: a*, twig and bud with young larvæ in position; *b*, young stem-mother; *c*, antenna; *d*, tarsus; *e*, rostrum; *f*, waxy rod—much enlarged (original).

The dorsum is but slightly convex and surrounded with a groove-like depression near the margin. The antennæ are three-jointed, with the third joint much the longest, which is rather more than twice the length of the two basal joints combined and about as long as the hind tibiæ. It grows slightly stoutest toward the end and is indistinctly and irregularly annulated, bearing one or two short and colorless, movable, sensorial thumbs near the apex, and two or three short, stiff bristles at the tip. The legs are rather stout and long, and all the tarsi provided with four long and capitate digitules, of which the upper pair are longest. There are also two long and stout backward-curved bristles near the apex of the posterior tibiæ, one or two such bristles about the middle, externally, of the second joint of the hind tarsi, and a finer and straight bristle at the apical angle of the first joint. The rostrum is long and reaches beyond the base of the abdomen, the third joint being very

long and slender, with its basal section bulbous. Before attaining maturity the young stem-mothers cast three skins, which are usually crowded into the opening of the gall, each stage lasting about a week, the last skin being cast between the 15th and 20th of May.

Stem-mother, second stage (Fig. 3).—The young stem-mother, after having cast her first skin, measures between 0.4 and 0.6^{mm} in length, and has become much stouter and of a broadly oval shape. She is dark purplish or almost black, with antennæ and legs paler; she is slightly pruinose and provided each side of the abdomen with a brush of white and glistening secretion, which grows gradually longer as she advances in age, though lacking entirely the characteristic glassy rods on the back and sides of the young larvæ. The antennæ are still of about the same length as in the first stage, though the third joint is either of a uniform thickness or slightly stoutest at base and without any annulations. The rostrum has become much shorter and stouter and reaches barely to the median coxæ. The digitules of the tarsi and the bristles of the posterior tibiæ and tarsi have become much shorter and finer, while the digitules have become simple. All secretory tubercles or pores have disappeared, except three or four at each side of the abdomen, which, however, are less prominent than in the young larva, and become entirely obsolete in the cast skin.

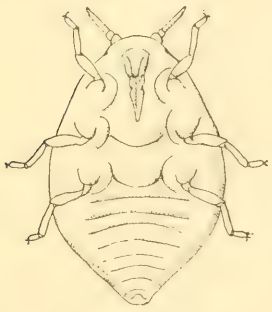


FIG. 3.—*Hormaphis hamamelidis:* Second stage of stem-mother, ventral view - much enlarged (original).

Stem-mother, third stage.—After casting a second skin she measures from 0.7 to 1^{mm} in length. She is again stouter than before and contains already a number of partly developed embryos. She is dark purplish or brownish and is covered with a mealy secretion, giving her a pruinous appearance. There are now also apparently six or seven rows of more or less confluent tufts of a white and glistening, straight, and evenly shorn secretion each side of the dorsum, directed toward the median line. The antennæ and legs are very similar to those of the previous stage, except that the third antennal joint has become stouter at base and more distinctly tapering. The digitules, especially those of the posterior tarsi, are longer and stouter, though apparently simple, and the bristles of the posterior tibiæ and tarsi more prominent. Otherwise they are very similar to the larvæ of the second stage.

Adult stem-mother, fourth stage (Fig. 4).—About the middle of May the young stem-mother casts her third or last skin, and soon after having matured proceeds to produce her progeny and continues to do so during the following three or four weeks, or till about the middle of June, until her stock of larvæ is exhausted, depositing from

4 to 6 or more each day until, by the commencement of June, each gall may contain from 100 to 120 of her progeny in various stages of development, which, after casting several skins, acquire wings and gradually depart in quest of their appropriate food plant provided by nature for their offspring. The adult stem-mother, after having cast her last skin, measures from 1.2 to 1.4^{mm} in length, and is at first of a broadly oval or pyriform shape, being broadest near the end of the abdomen and slightly tapering toward the head, increasing gradually in diameter during the increase of and development of her ova until she becomes almost globular. She is of a dark purplish color, with the eyes black and the antennæ and legs dusky. At first she is dusted with a white, powdery secretion, which is soon followed by a rather long, white, and shaggy secretion, covering almost the entire abdomen. This secretion is, however, gradually more or less completely lost as the occupants of the gall increase in numbers, being rubbed off by the movements of the inhabitants as well as by coming in contact with the walls of the gall and the globules of ejected liquids which gradually accumulate. The antennæ and legs are very similar to those of the third stage, although the digitules appear to be slightly capitate. Those of the claws are very fine and about the length of the claws. The rostrum is short and stout and reaches only between the anterior and median coxæ. There is now a distinct, though rather short and broad, almost semicircular tail, bearing two fine bristles, while the last abdominal segment, which is more or less completely covered by the tail, has become distinctly bilobed, each lobe being provided with two stout bristles arising from small tubercles, the edge of both sides being also lined with small spines. After being completely exhausted and empty of ova the stem-mother shrivels up and dies.

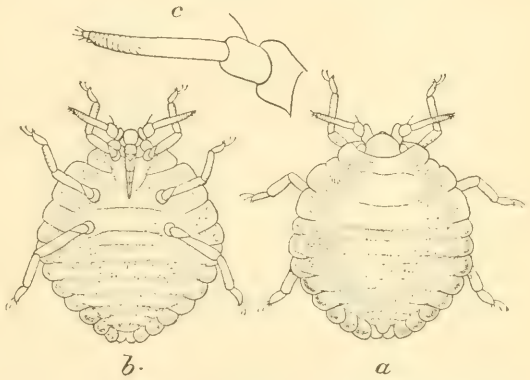


FIG. 4.—*Hormaphis hamamelidis: a*, adult stem-mother, dorsal view; *b*, ventral view; *c*, antenna—much enlarged (original).

SECOND OR MIGRATORY GENERATION.

The development of the second generation, or progeny of the stem-mother or gall-maker, is more rapid, and is completed within sixteen to twenty days, all of which prove to belong to the migratory form. The earliest of these migrants make their appearance toward the end

of May or early in June; the remainder leaving the galls gradually till the end of June or early in July, by which time the last ones have disappeared. Frequently, however, a few stragglers may be met with as late as the end of July issuing from belated galls, the product of a few stem-mothers, hatching from eggs deposited very late in fall during an exceptionally favorable season.

There is but a single migratory generation in each gall, all of which, after casting four skins, become winged and leave the gall after having fully matured and migrate to birches, where they deposit their larvæ on the underside of the leaves, which, in favorable years, become frequently covered with migrants. So keen and unerring must be the instinct of these migrants to discover their secondary

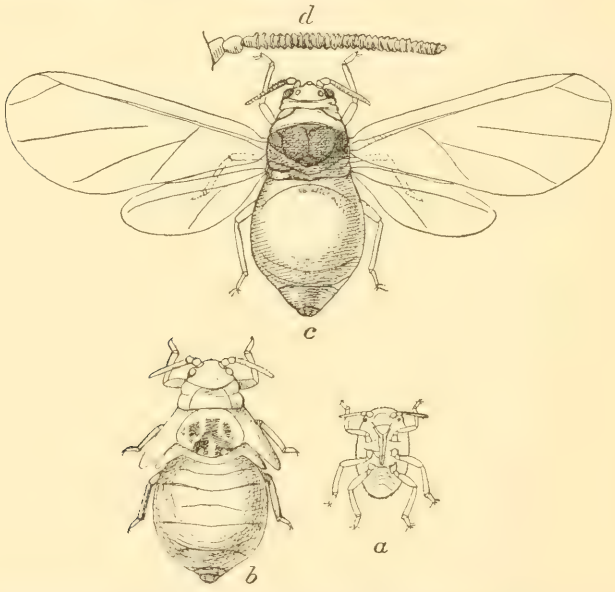


FIG. 5.—*Hormaphis hamamelidis:* Second generation; *a*, young larva; *b*, pupa; *c*, spring migrant; *d*, antenna.—Much enlarged (original).

host that they frequently fly great distances in search for birches, which may not be growing in the immediate neighborhood of witch-hazels, as is the case in some localities along the shore of the Potomac River, which they are compelled to cross in order to reach young birches on the opposite shore.

Second generation, first stage (Fig. 5).—The young larvæ of this generation are at first pale purplish and slightly covered with a white powder; they soon change to a dark purplish-brown, the eyes are black, and the antennæ and legs pale dusky. They measure about 0.3^{mm} in length, and are of a regularly oval shape; the front of the head is almost straight, and the surface of the body appears to be densely granulated. There are two rather long bristles on the front

of the head, two each side of the thoracic, one each side of the abdominal segments, and two at the end of the body, all of them arising from a small tubercle. The rostrum is stout and reaches nearly to the posterior coxæ. The antennæ are rather short and stout, barely reaching to the mesothorax; each of the two basal joints bears a long and stout bristle; the third joint is slightly curved inward and of almost equal thickness or slightly clavate with the apex, which bears two or three small bristles, bluntly rounded; its surface is faintly annulated or scaly; there are from one to three minute sensorial thumbs near its apex. The legs are stout and rather long; the digitules are simple, or faintly thickened toward the end, the lower pair of which is wanting.

Second generation, second stage.—The larvæ in the second stage are about twice as large as in the first and more elongated, with the antennæ longer and stouter; the third joint is slightly tapering and without any traces of annulation; the rostrum reaches only the median coxæ. In general appearance and coloration they are identical with the young larvæ.

Second generation, third stage.—In the third or semipupa stage they are 0.7 to 0.8^{mm} in length and considerably stouter than before and of a purplish-green, with the head and rudimentary wing pads of a dirty greenish-white, eyes brown, and the antennæ and legs whitish or faintly dusky. The future wing pads are now represented by rather prominent, rounded swellings. The antennæ are still longer and stouter than in the previous stage; the third joint is straight and somewhat tapering and the sensorial thumbs minute. The rostrum reaches nearly to the median coxæ. Front of head somewhat concave.

Second generation, pupa or fourth stage.—The fully developed pupa varies between 1 and 1.4^{mm} in length. They are of a dark purplish color, with the eyes dark brown and the antennæ, legs, and wing pads whitish. Front of head straight or slightly convex. The rostrum is short and stout, and reaches but slightly beyond the anterior coxæ, Antennæ and legs similar to those in previous stages, though proportionately longer. The third antennal joint is very long and stout, slightly tapering and slightly curved, and bears from one to three minute sensorial thumbs. All of the pupæ, if not rubbed, are furnished at each side of the abdomen with a dense brush of a white and hair-like secretion.

Second generation, migratory or fifth stage.—The mature migrants vary somewhat in coloration; they are generally of a dark purplish, purplish-brown, or black color, though frequently purplish-red or dark greenish-brown, with antennæ, thoracic lobes, and legs black. The wings are colorless or faintly dusky, the costal cell and stigma brownish, and the veins black. They measure from 1.2 to 1.6^{mm} in length and have an expanse of wings of 4 to 5^{mm}. The wings are carried flat in repose. Antennæ three-jointed, rather short and slender. The two

basal joints are very short and subequal in length; the first joint is cylindrical and obliquely truncate at the apex, while the second joint is almost globular. Joint three is very long in comparison to the two basal joints and five or six times as long as either of them. It is of uniform diameter and bluntly rounded at the apex, where it bears two or three short hairs, and deeply divided by thirty to thirty-six more or less regular or complete annulations, without a trace of divisions into separate joints. The legs are slender and almost destitute of hairs, which are somewhat more numerous and spine-like toward the end of the posterior tibiæ. There are four slender, subequal, and capitate digitules on each tarsus. Stigma long, narrow, lanceolate, and as broad as the costal cell, its basal angle almost obsolete. Veins simple; the second discoidal arises in front or beyond the middle of the first discoidal vein, though occasionally both start from the same point. The basal third or more of the third discoidal is obliterated. Stigmal vein short and almost straight. In the hind wings the second discoidal is generally wanting, frequently a stump of it or the entire vein may be observed arising from the first; sometimes both may start from the same point, though in rare cases both are normal, arising some distance from each other, and almost parallel to each other. The head is slightly convex in front. The rostrum is short, reaching but slightly beyond the anterior coxæ. Tail small, knob-like, bearing six to eight short hairs; last abdominal segment bilobed, each lobe provided with five or six hairs. There is also a small, blackish tubercle each side of the anterior four segments of the abdomen.

After feeding for some time on the juices of the gall, in order to become fully mature and strong enough for migration, and also to hasten the development of the embryonic larvæ, they abandon their old home in search for the appropriate food plant for their progeny, to insure the perpetuation of their race. Each of these migrants contains about fifty larvæ, which, after reaching the birches, are deposited on the under side of the leaves; on reaching the birches they deposit from six to eight larvæ each day until their stock of larvæ is exhausted, after which they shrivel up and die.

Third generation, first stage (Fig. 6).—Young larvæ of this generation were first observed during the first days of June and the first mature and apterous females on the 18th of the same month, the insects accomplishing all their changes within fourteen days. The young larvæ are at first of a pale yellowish color, but soon change to a brownish yellow; the eyes are dark purplish and the antennæ and legs colorless. The young larvæ are very small, barely 0.2^{mm} in length and broadly oval; the abdomen is comparatively small in proportion to the size of the larvæ and only about one-third the length of the entire insect. The entire margin of the body is studded with short and stout secretory tubercles; sixteen of which are along the

front edge of the head; about five or six each side of the thoracic segments, two each side of the abdominal segments, and seven or eight to ten on the last or eighth segment; from each of which issues a short, stout, truncated and cylindrical, glassy, transparent, and beautifully iridescent, waxy rod. There is also a series of similar though shorter rods along the middle of the back. The rostrum is stout and reaches to or between the posterior coxæ. The antennæ are rather long and slender, and about as long as the posterior tibiæ; they are faintly serrate or annulated and slightly clavate, with a notch near the apex, containing a small, movable thumb; the tip is bluntly rounded and bears two or three small hairs. Legs rather long and stout; the posterior tibiæ bear one or two rather long bristles and the tarsi a similar one on its external edge. The upper pair of digitules are long, slender, and capitate; the lower pair is wanting.

FIG. 6.—*Hormaphis hamamelidis:* Third generation: young larva, ventral view—much enlarged (original).

Third generation, second stage.—After having cast their first skin the larvæ measure about 0.4[mm] in length and have become proportionally broader. The antennæ have become now very short, almost rudimentary, and composed of two, or sometimes three, more or less distinct joints, the last or last two joints, as the case may be, being about twice the length of the first, obliquely truncate at the apex, and bears a minute thumb at the inner apical angle. The tarsi of the anterior and median legs have been lost or they may sometimes be represented by a minute rounded stump. The tarsi of the posterior legs are deformed; their claws are lost or represented by a small spine-like process. The digitules are still present, though simple. The rostrum is stout and reaches to the meta-sternum. The number and arrangement of the secretory tubercules are about the same as in the first stage.

Third generation, third stage (Fig. 7).—In the third stage they are broadly oval; the antennæ have become still shorter, while the rostrum reaches only between the median coxæ. In other respects they are similar to the previous stage.

Third generation, fourth or Aleurodiform stage (Fig. 8).—Toward the middle or end of June the insects cast their third or final skin and assume a most remarkable mimicry; in fact, mimic now so closely

certain Aleurodids that for some time I was completely deceived as to their true nature, which only after close examination of numerous specimens, in connection with its earlier stages, was disclosed. When seen on the leaves they are to all appearance true Aleurodids, both in shape and size, resembling to some extent the scale-like form of *Aleurodes corni* or related species. At first they are pale brownish, but change gradually to a dusky or black color. They are almost circular, flat, and rather coarsely rugose above, with the ventral side quite convex, and measure, when fully mature, about 0.6mm in length and are surrounded by a rather long fringe of cylindrical, waxy rods; the basal one-third or one-fourth of these rods is perfectly white, while the remaining two-thirds or more is glassy and iridescent. There is also a medio-dorsal group of rather long rods, identical with those of the lateral margin, which are curved in various ways; all of which, combined, give to the insect a peculiarly pretty appearance. If denuded of the waxy rods there is seen a continuous double row of stout secretory tubercles surrounding the body excepting the free and movable terminal segment. The dorsal tubercles are irregularly arranged along the middle of the back and vary considerably in the number in each of the various groups.

FIG. 7.—*Hormaphis hamamelidis:* Third generation, third stage; *a*, dorsal view; *b*, antenna—much enlarged (original).

Occasionally one or two tubercles or pores may be observed near the posterior margin of the head. There are five to fifteen on the prothorax, six to twelve on the mesothorax, five to eight on the metathorax, three to five on the first abdominal segment, two or three on the second, and one or two on the third segment. The antennæ in this stage have become extremely minute and rudimentary, and are either one or two jointed. The rostrum is short and reaches but slightly beyond the anterior coxæ. The legs are as in the larval stages. The tail is very small and knob-like, and bears two short bristles. The last segment is bilobed and completely hidden by the semicircular, penultimate segment; each lobe of it bears five or six bristles, arising from a small tubercle. In this stage they are perfectly stationary, as in *Aleurodes*, and tightly cemented to the leaf, so that it is almost impossible to remove them without injury.

Fourth and fifth generation, or the second and third Aleurodiform generation.—The following two generations—the fourth and fifth—

are in every particular essentially identical with the third generation. Both of these generations are also Aleurodiform, differing but slightly either in coloration or size from the two preceding generations, obviating, therefore, the necessity of repeating their cycle of transformations. The fifth generation attains maturity about the middle of August or later, and gives birth to larvæ of the sixth generation. The number of larvæ deposited by individual females of the Aleurodiform

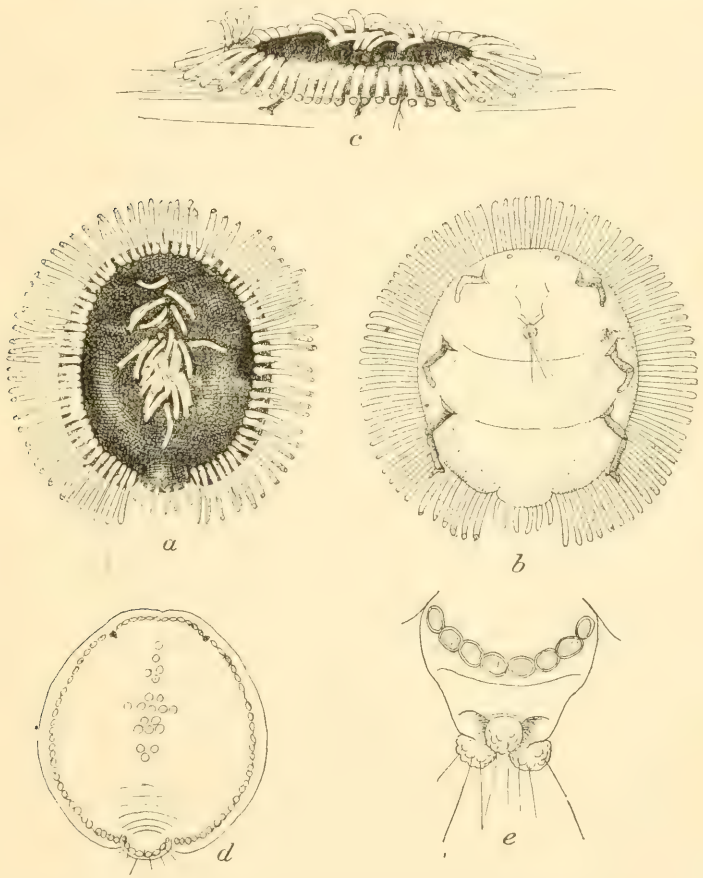


FIG. 8.—*Hormaphis hamamelidis:* Third generation, fourth or final stage; *a*, dorsal view; *b*, ventral view; *c*, lateral view; *d*, dorsal view, showing arrangement of pores; *e*, end of body—much enlarged (original).

generations is extremely variable. Many of these females are completely devoid of ova and die soon after attaining maturity; others may deposit one or a few larvæ, while the most prolific deposit from ten to fifteen or more.

With the appearance of the sixth generation a new cycle of forms begins to make its appearance, in which the aspect of the insects has changed completely, so much so that the casual observer would fail

to trace a connection between them and the Aleurodiform generations. Continued observations, both in the woods and on small, potted birches to which the insects were transferred, removed, however, all doubt as to the close relationship of these aberrant forms. This generation develops in time into the return migratory generation.

Sixth generation; return migrants; first stage.—By the end of August or early in September the females of the last Aleurodiform generation, after having become fully mature, proceed to produce a supplementary generation of larvæ, and continue to do so until exhausted. The number of larvæ produced by each female varies, as in previous generations. As a rule, however, they appear to be more prolific, since I have observed in one female about thirty embryos, in consequence of which, in favorable years, the underside of the leaves of birches may become completely covered with larvæ of them in various stages of development.

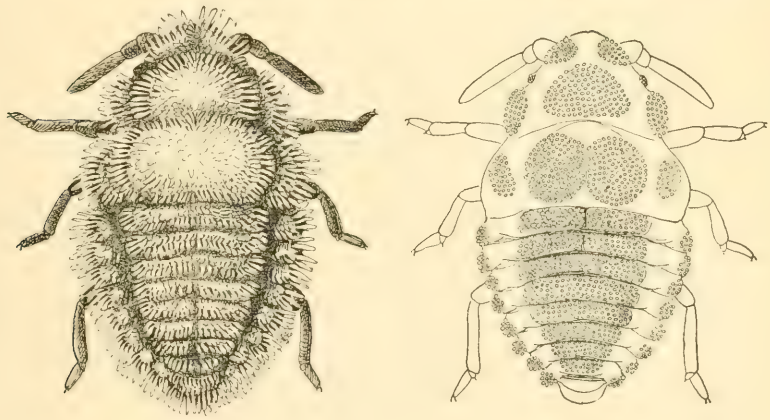
The recently deposited larvæ are barely 0.2^{mm} in length, oval, and of a yellowish-brown color, changing gradually to purplish-brown, with antennæ and legs whitish. They are at first naked, but soon become covered with a pruinous or bluish-white secretion, giving them a moldy appearance. After growing for some time, there forms a broad, medio-dorsal stripe of evenly shorn, dense and bristly, white and iridescent threads of waxy secretion. A dense fringe of similar glistening threads surrounds also the entire body, leaving the subdorsal region each side of the median line bare or only covered with a powdery secretion, and look now quite unlike the Aleurodiform generations. They are rather convex; the head is narrower than the thorax and arcuate in front; eyes larger than before; abdomen small or only about one-third the length of the entire insect. The number and arrangement of the tubercles surrounding the body is as in previous generations. In addition to tubercles, there are now two median groups of two or three very distinct pores or tubercles on the head slightly in front of the eyes, four medio-dorsal groups of three to five pores or tubercles on each side of the thoracic, and two groups of one to three pores each on the abdominal segments except the last. Antennæ, legs, and rostrum are very much as before. The third antennal joint is fusiform, slightly annulated, and bears from one to three minute thumbs near the apex. The upper digitules of the tarsi are slender and distinctly capitate. The lower digitules are wanting.

Sixth generation; second stage (Fig. 9).—Length of body, 0.4 to 0.6^{mm}. In coloration and general appearance they are similar to larvæ in the first stage, though they are considerably larger and stouter in proportion, with the sides of the pro- and mesothorax considerably swollen. They are now densely covered with a white and glistening, straight and evenly shorn, hair-like secretion, issuing from large, more or less confluent medio-dorsal and lateral compound glands or tubercles, which, on the abdomen, form broad, transverse

bands, giving them a peculiarly bristly or hairy appearance. The antennæ are very stout, much longer than before, and distinctly tapering. The rostrum is stout and reaches between the anterior and median coxæ. Legs as in previous stage, though longer and stouter.

Sixth generation; third or pre-pupa stage.—Length of body, 0.6 to 0.8mm. In this stage they are also densely covered with hair-like secretion resembling still to a great extent the second larvæ, except that they are still larger and stouter, and that they have already acquired wing pads. The antennæ are now very long and stout, the third joint being longer than the posterior tibiæ, slightly tapering and without a trace of annulation, and with the usual movable thumb and three stiff bristles on the apex.

Sixth generation; fourth or pupa stage.—Length of body, 1 to 1.6mm. They are in every particular like the pre-pupa, except that



a *b*

FIG. 9.—*Hormaphis hamamelidis:* Sixth generation, second stage; *a*, dorsal view; *b*, dorsal view denuded, showing arrangement of pores—much enlarged (original).

the wing pads and the antennæ are still longer, and that the annulation of the third joint of the future imago may be more or less distinctly seen through the transparent skin. They are of the same dark color as before, with the head and prothorax paler, and the eyes, thoracic lobes, and wing pads blackish. The digitules are apparently simple and bristle-like.

Sixth generation, fall migrant (Fig. 10).—Having cast their fourth or final skin, they acquire wings and, after feeding for some time to attain complete maturity, forsake the birch and migrates back to witch-hazel to deliver themselves of the ultimate or sexual generation. Each migrant, according to size, contains from seven to fifteen or perhaps more larvæ. Migration continues for about a month and a half, according to conditions of the season and other natural causes, and commences usually toward the end of August and terminates during the early part of October. In general appearance they are essentially

the same as those of the spring migrant from the witch-hazel, though they are uniformly smaller and measure from 0.8 to 1.4mm, or rarely 1.6mm in length, with an expanse of wings varying between 3 and

FIG. 10.—*Hormaphis hamamelidis;* sixth generation, return migrant: *a*, pupa, denuded, showing arrangement of pores; *b*, imago; *c*, antenna—much enlarged (original).

4.4mm. The antennæ are also proportionally shorter, with the third joint divided by twenty to thirty annulations. They are dark purplish brown, the prothorax paler, and the eyes and thoracic lobes black, the legs yellowish brown.

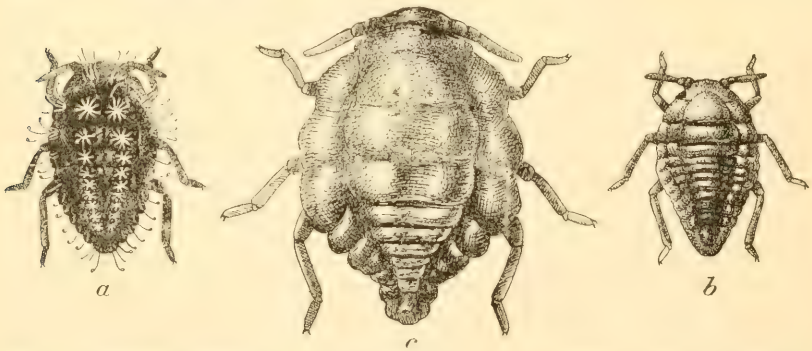


FIG. 11.—*Hormaphis hamamelidis;* sexual generation: *a*, young larva; *b*, male; *c*, female—much enlarged (original).

Seventh, or sexual generation. (Fig. 11.) *Female, first stage.*—The young larvæ of this generation are oval, with the median line slightly and the dorso-lateral line deeply impressed, and measure

0.2 to 0.4[mm] in length. These, as well as the three following stages, are of a brown or purplish-brown color, the eyes deep purplish, and the antennæ and legs pale dusky. All are covered with a delicate, pruinous pubescence, intermixed with a short, glistening and hair-like secretion which gives to them a moldy or bluish appearance, all of which in the two following stages becomes gradually so dense as to cover the entire insect. There are also, as in former generations, two medio-dorsal and a marginal row of short, transparent, and iridescent waxy rods, issuing from short secretory tubercles. In this stage there are about twelve tubercles along the front edge of the head, two or three each side on the thoracic segments, one each side on the abdominal segments, and two at the end of the body. There are also two tubercles about the middle of the head, two medio-dorsal groups of two pores each on the thoracic segments, and two median tubercles on the abdominal segments. Antennæ and legs are stout and rather long, with two small bristles on the front of the head, a long bristle at the apex of the second antennal joint, and three short and spine-like bristles at the tip of the last; digitules and bristles of tibiæ and tarsi as in previous generations. The rostrum is stout, highly developed, and reaches to the abdomen.

In favorable years these larvæ become frequently so numerous as to cover the entire underside of some of the leaves of the witch-hazel, in consequence of which numerous predatory insects, such as larvæ of Syrphid flies, Chrysopids, Coccinellids, and various mites make their appearance and commence their work of destruction, so that within a few days they may be found with great difficulty.

Female, seventh generation, second to fourth stage.—In the following three stages they resemble each other closely, except that they gradually grow larger, become more convex and more pyriform in shape, and that the antennæ and legs grow longer and stouter. All are dark purplish, and densely covered with hair-like secretion. The secretory tubercles increase gradually in numbers and prominence, whereby the segmentation of the body is strongly brought out. In the fourth stage they measure about 1[mm] in length. The legs and antennæ are considerably longer and stouter than in the other stages, though otherwise very similar, and the rostrum shorter, reaching only between the anterior and median coxæ. There are now two large groups of secretory tubercles at the front of the head; a group of 20 to 24 each side of the prothorax, 17 to 20 each side of the mesothorax, 11 to 16 or more each side of the metathorax, 8 to 10 each side of the first three segments of the abdomen, 3 to 6 each side of the other four segments, and about six on the terminal one. There are also two median groups of 7 to 10 tubercles on the head between the eyes; two medio-dorsal groups of 10 to 15 on each of the thoracic segments; 8 to 10 or more on the four anterior segments of the abdomen, and from three to six on the other three segments.

Seventh generation, mature female.—After having cast the last skin they measure but slightly over 1[mm.] in length. They are broadly pyriform, highly convex above and quite flat beneath, surrounded with a rather broad and deep dorso-lateral depression. They are polished, of a deep black or purplish black color, and without a trace of secretion of any kind, and, when seen on the leaves, remind one strongly of certain small Coccinellids, such as *Pentilia*, and also of some of the Oribatid mites. All of the secretory tubercles have now completely disappeared. The head is arcuate in front and bears two to four small hairs. Eyes small, each composed of three ocelli. The rostrum is highly developed and reaches almost to the median coxæ. The antennæ are much longer than in the last larva stage, and about as long as the posterior tibiæ and tarsi combined; the two basal joints, as usual, are stoutest, shortest, obconic, subequal in length, and provided with a short bristle near the inner apical angle; the third joint is very long and slender, of uniform diameter, rather densely and sharply serrated or annulated, provided with the usual sensorial thumb and two or three short hairs at the apex. The legs are long and stout, and bear the usual bristles on the tibiæ and tarsi; the digitules are well developed and capitate, the lower pair being much shorter and but slightly longer than the claws. The posterior tibiæ are stouter than the others, and are provided with a considerable number of sensorial pores or tubercles. The tail is small, transversely oval or knob-like, and bears six bristles; the terminal segment is bilobed, each lobe bearing three to four bristles. Each female contains from five to ten eggs, which, shortly after copulation, are deposited around the base of the leaf buds for next year's brood.

Seventh generation, male.—On account of the very small size of the male and its general similarity to female larvæ I failed to ascertain through how many transformations it passes, though they are evidently the same as those of the female. The mature male measures 0.4 to 0.6[mm] in length, and about one-half or less the size of the female. It is of the same black or purplish-black color and of an elongated pyriform shape, being broadest about the middle of the thorax and gradually tapering toward the end of the body; the front of the head is rounded and bears two small hairs. Surface of body densely reticulated. Secretory tubercles are wanting. The antennæ are considerably longer and more slender than in the female; the two basal joints are subequal in length; the first joint is stoutest and about as long as broad, stoutest near the truncated apex; the second joint is clavate and more elongated; both bear bristles at the inner side near the apex. The third joint is very long, slender, and of equal diameter up to the terminal thumb, slightly curved inward, profusely serrate or scaly and bears along its external edge from ten to fifteen or more minute and colorless sensorial thumbs and three small hairs at the apex. Eyes composed of three ocelli. The rostrum is highly

developed and reaches beyond the median coxæ. The legs are long and more slender than in the female. The tail is small and knob-like, and bears two small bristles; the last segment is rounded and provided with four small bristles. The mature male is extremely active and restless and is continually running about in search of mature females. Copulation lasts but a short time.

HAMAMELISTES SPINOSUS Shimer.

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Hormaphis spinosus, Bull. U. S. Geol. Geog. Surv. Terr., Vol. V, No. 1, p. 14, 1879.
Hormaphis papyraceæ Oestlund, Geol. and Nat. Hist. Surv. of Minn. Bull. 4, Synopsis of Aphidæ of Minn., p. 13, 1887.

The life history of the second species of gall-making Aphids, inhabiting both the witch-hazel and birch, is as remarkable and interesting as that of *Hormaphis hamamelidis*. Its earlier generations, as in the former species, subsist upon the witch-hazel, but instead of infesting the leaves select the young and dormant flower buds for their future operations, which gradually are changed into conspicuous, spiny galls, the architects of which, at the proper time, forsake also their old home and migrate to the birches to consign to them their progeny in order to complete the cycle of existence of the species, but, unlike *H. hamamelidis*, which completes its cycle within the space of one year, this species hibernates on the birch, on which, during the following spring, it produces two additional generations, the second one of which returns during June to the witch-hazel for the purpose of producing the sexed generation. These return migrants appear just about the time that the spring migrants of *H. hamamelidis* leave their galls, so that during this cross migration both species may frequently be found simultaneously upon both plants, which occurrence during my earlier observations caused considerable confusion and speculation whether these two forms were only variations of one or whether there were really two distinct species. Continued studies, however, have clearly demonstrated that these two forms, notwithstanding their great similarity in venation and general appearance, are good species, belonging to two distinct genera.

The genus *Hamamelistes* was described by Dr. H. Shimer, of Mount Carmel, Ill., in the Transactions of the American Entomological Society, vol. 1, page 284, 1867, to include two gall making species found on the witch-hazel, without, however, being aware that the first one of these two species, to which he gave the name of *Hamamelistes cornu*, had previously been described by Dr. A. Fitch under the name of *Byrsocrypta hamamelidis*, for which subsequently Baron Osten Sacken erected the genus *Hormaphis*. Since, however, the antennal characters of *spinosus* are markedly different from those of

hamamelidis, the generic name of *Hamamelistes* will have to be retained for this species.

In 1879 it was again partly described by Prof. C. V. Riley in the Bulletin No. 1 of Volume V of the U. S. Geol. and Geog. Survey, p. 14, who erroneously referred it to *Hormaphis*.

Mr. O. W. Oestlund, while studying the Aphides of Minnesota, described an insect, which he found to corrugate the leaves of birches, in Bulletin 4, of the Geological and Natural History Survey of Minnesota, page 17, 1887, under the name of *Hormaphis papyracea*, not being aware that he had discovered the return migrant of *Hamamelistes spinosus*. The complex history of these two remarkable species has remained a sealed book up to the present time, when, at last, it has been solved.

My own acquaintance with the birch-inhabiting form of this species dates back to May, 1887, when I discovered the younger stages of it on the young leaves of a small birch at Richfield Springs, N. Y., but failed, on account of the immature state of the insects, to recognize its generic position. It was again found by me in June, 1893, on leaves of young birches at Charlton Heights, Md., in various stages of development, including the migrant, but considered it to be a new species of *Hormaphis*, which I later found to have been described by Mr. Oestlund. My failure to recognize it at that time as the return migrant of *spinosus* was in a great measure due to the fact that at the date of finding these migrants on the birches I observed also young galls of *spinosus* on the witch-hazels.

The geographical distribution of this species depends in a great measure on the presence of both plants in the same locality. In favorable seasons it may become so numerous as to cause great injury to the foliage of birches, inducing the leaves to fall prematurely.

Winter egg (Fig. 12).—The winter eggs of this species, unlike those of *Hormaphis hamamelidis* and the majority of other Aphids, are deposited from about the middle of June to early in July, instead of during the fall of the year, and hatched by the end of May or early in June the following year, remaining dormant almost a whole year, whereas in the other species it takes only about one-half of that time. These eggs are commonly deposited between or near the crotches formed by the twigs and petioles of the flower buds, the scars left by previous flowers or seed capsules, and in crevices of the bark, or similar sheltered positions. That the instinct of the migrant is rather defective in selecting the proper shrubs of witch-hazel for the continuance of its race has been demonstrated by the fact that it will migrate indiscriminately to both the bearing and immature plants, on account of which the young stem-mother, hatching from eggs deposited on immature plants, is doomed to perish through absence of flower buds on which to settle. I have repeatedly found large numbers of the sexes and their winter eggs on immature

plants, though never a gall of this species on them, whereas the other species, inhabiting the leaves, thrives equally well on the smallest plants but a few inches high, as well as upon fully grown trees, and is therefore the more common and more numerous of the two.

The eggs of this species are rather peculiar, quite flat, about three times as long as broad, and about 0.2[mm] long; they are regularly oval, and covered with a glistening, hair-like secretion, applied to them when deposited, from the hair-like secretion on the abdomen of the female, which gives to them a hoary appearance, corresponding quite well with the pubescence of the twigs, and rendering them very difficult of detection. They are at first of a pale yellowish color, but change gradually to a dark gray or blackish color, corresponding more or less closely with the color of the bark, which makes it still more difficult to detect them. They are tightly glued to the twigs, and are so extremely delicate that it is almost impossible to remove them without breaking.

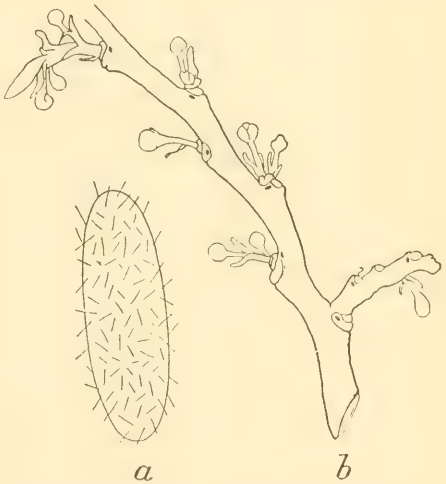

FIG. 12.—*Hamamelistes spinosus: a*, winter egg, much magnified; *b*, twig of witch-hazel with young flower buds and eggs in position – natural size (original).

The gall (Fig. 13).—At the time of hatching of the eggs of this species, which takes place from the middle of May till early in June, the young flower buds measure about 1 to 1.4[mm] in diameter. They are globular, with three shallow longitudinal grooves, situated on a short, rather stout, and succulent petiole, which is surrounded with four or more small and lanceolated leaflets. They are of a yellowish-green color and densely pubescent or hairy. The young stem-mother, after hatching, readily finds the buds and selects almost invariably that side of it directed toward the twig and settles down near the base in one of the grooves of the bud. The ensuing irritation, caused by the sucking of the insect, and probably also through injection of an irritating fluid, checks the longitudinal growth of the petiole, but hastens that of the bud, especially that side of it opposite the insect, which at once commences to lengthen, to broaden, and to curve over toward the gall-maker, and to acquire a beautiful rosy color. The formation of the young gall proceeds rapidly, so that within a few days the insect is completely inclosed, leaving but a transverse scar and small opening where the insect had settled, by which time the original structure and component parts of the buds have become com-

pletely fused. The newly formed gall is also globular and but slightly larger than the original bud. They grow now rapidly, so that by about the middle of June the oldest or earliest formed galls are about half grown, have lost their beautiful rosy tint, and are now of the same pale, dingy green color of the buds. They are globular; the opening or mouth is closed and indicated by a fine whitish pubescense; while the leaflets surrounding the petiole have dropped. The surface of the gall has become densely tuberculate and in addition is covered with a greenish-white pubescence, while the tubercles are covered with

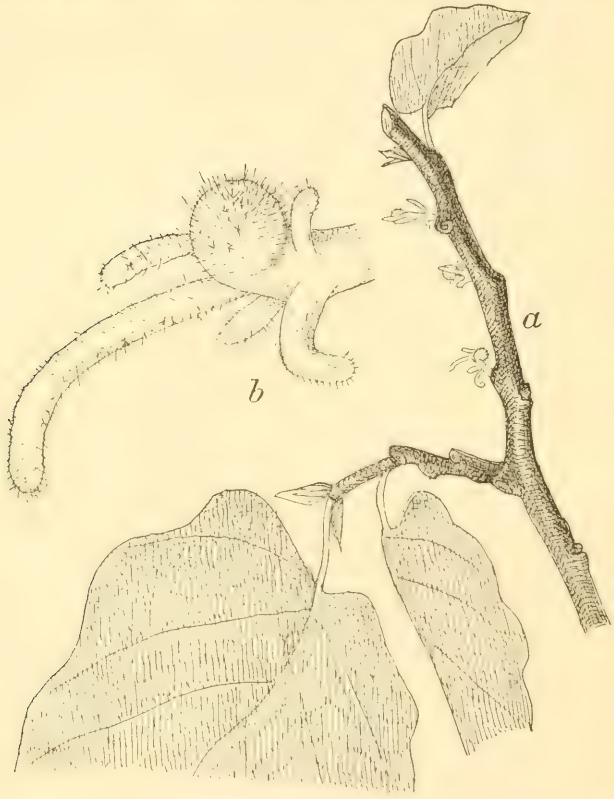

FIG. 13.—*Hamamelistes spinosus: a*, twig of witch-hazel with young galls, natural size; *b*, young gall—much magnified (original).

the peculiar brown and branching papillæ which are noticed on the buds. They are fully grown by the end of June or early in July, and have acquired the characteristic shape.

The mature galls (Fig. 14) vary more or less in shape and size. Their shape varies from globular to ellipsoidal and their size from 10 to 30^{mm} in length by 10 to 12^{mm} in diameter. Their surface, when fully grown, is now covered with long and stout more or less curved spines or teeth, which frequently may attain a length of 8^{mm} or more, though as the galls grow older and become dry these spines become

shorter and blunter. The whole aspect of these galls when fresh is that of a miniature seed capsule of the common Jamestown weed (*Datura stramonium*). They are of about the same green color of the leaves and studded with reddish brown papillæ. The orifice or mouth, at the base of the gall, is circular and 1 to 2 mm in diameter, with its external prolongation more or less decidedly funnel-shaped, terminating in a rounded or bulging rim, to allow the departing migrants space to adjust their wings for flight. The inner wall of the gall is smooth and coated with a delicate layer of a white secretion, to prevent the watery fluids, or honeydew, expelled by the insects from adhering to the surface, as a preservative against premature decay or the drying up of the tissues of the galls. After attaining their full

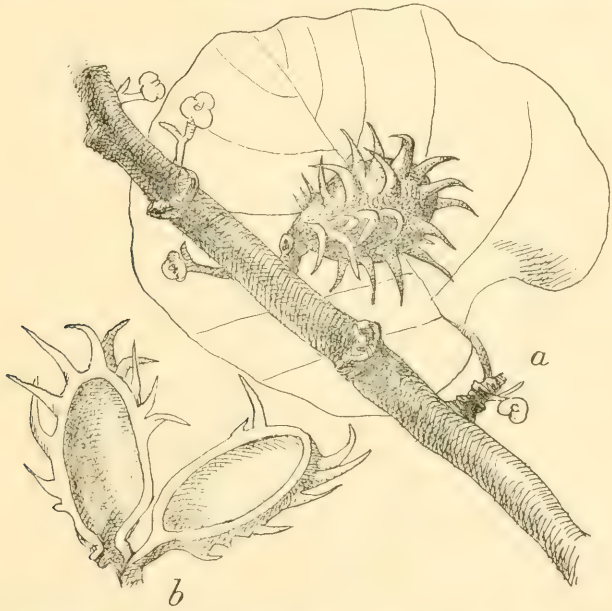

FIG. 14.—*Hamamelistes spinosus: a*, mature gall; *b*, section of gall—natural size (original).

growth, they remain fresh and succulent for a long time, so as to enable the latest additions to their inhabitants to acquire maturity. The majority of these galls become dry and brown by the end of summer, though occasionally fresh and green ones, containing the insects in various stages of development, may even be found as late as the end of November.

Stem-mother: first stage.—The young stem-mother, after hatching, is extremely small and measures only about 0.2 mm in length. She is broadly oval and of a dark purplish-brown color; the eyes, antennæ, and legs are blackish. The head is broadly rounded in front and bears two small bristles. There are three short and stout secretory tubercles each side of the prothorax, arranged in a triangle—two each

side on the other thoracic segments; one each side of abdominal segments one to seven and two, bearing two small bristles, on the last segment. There is also a semicircular row of four similar tubercles near the inner edge of the eyes and a transverse row of four between the eyes; two outward-curved medio-dorsal rows of four tubercles in each row on the prothorax; a transverse row of four tubercles on the meso- and metathorax; two median tubercles on the first three abdominal segments and one on segments four to seven. The antennæ are short, four-jointed, and inserted on the underside of the head. The two basal joints are short, stout, and subequal in length; the third is longest and slightly stoutest at the apex; the fourth is somewhat shorter, clavate, and terminates in a short, blunt spur; both are slightly annulated or serrate and bear a slender cylindrical thumb near the apex. Legs stout; the posterior tibiæ bear near the end two

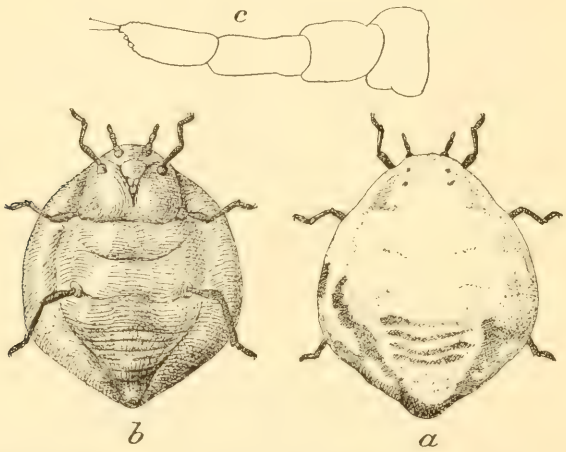

FIG. 15.—*Hamamelistes spinosus: a*, mature stem-mother, dorsal view; *b*, ventral view; *c*, antenna—much magnified (original).

long, backward-curved bristles, and the tarsi a similar one on their external edge. The digitules of all the tarsi are long and capitate, the lower pair being much the finest. The rostrum is long and tapering and reaches beyond the posterior coxæ.

In the following two stages the larvæ have lost all of the secretory tubercles, which are to some extent replaced by hairs. In other respects they are very similar to the first stage.

Adult stem-mother; fourth stage (Fig. 15).—The full-grown stem-mother is almost globular or broadly pyriform, about 2^{mm} long, and of a dark purplish-brown color, covered with a mealy secretion; antennæ, legs, and rostrum blackish. Eyes small and composed of three ocelli. There are apparently two bristles on the front of the head, two each side of the thoracic, and one each side of the abdominal segments. The tail is small, broad, knob-like, and bears two bristles; the last segment is broadly bilobed, and each lobe is furnished with about

eight bristles. Antennæ short, stout, and four-jointed; the two basal joints are shortest and stoutest, each bearing a bristle near the apex; joints 3 and 4 are longer and subequal in length, the third is clavate, and the fourth elongated oval; each bears a small thumb near the apex, and the fourth three small capitate hairs and a small spine at the tip. The rostrum is stout and reaches beyond the anterior coxæ. Legs short and stout; the digitules of the claws apparently wanting.

That the stem-mother of this species is extremely prolific was proved by the fact that one mature gall, found July 9, contained, besides the stem-mother, 220 of her progeny, in various stages of development, from the recently deposited larvæ to the winged migrants, the old mother being at the same time still very plump and almost globular, containing yet a large number of embryos, which, after all have been deposited, may increase her descendants to about 300. The galls are sometimes so completely crowded with the insects as to allow but little room for them to move about.

Second generation, first stage.—The young larvæ of this generation are brownish-red or grayish-green and gradually develop into the migratory form. They measure between 0.4 and 0.8^{mm} in length, and are about twice as long as broad, with almost parallel sides. The head is nearly straight or broadly rounded in front, and bears a rounded, fleshy tubercle. The abdomen is about one-half the length of the body; its segmentation very distinct. The head and prothorax are confluent and as long as the combined meso- and metathorax. The rostrum is stout and reaches almost to the hind coxæ. Antennæ four-jointed, curved inward, short and stout; the two basal joints are stout and short, the third and fourth are subequal in length; the third is clavate and the fourth slightly tapering; each bears a cylindrical and movable thumb. Legs stout and rather long; there is a rather long bristle near the apex of the femora; two, externally, on the tibiæ and one or two on the tarsi; digitules long, slender, and apparently simple; those of the claw are wanting. There are also four or more bristles along the front of the head, two each side of the thoracic, one each side of the abdominal segments, and four at the end of the body.

Second generation, second stage.—In this stage they are still very similar to the young larvæ, though they are much stouter and about 1.2^{mm} in length. The antennæ are now distinctly five-jointed, rather stout, and still more curved inward; the two basal joints, as usual, are short, the first stoutest; the other three grow gradually somewhat longer, the fifth being somewhat the longest and thinnest; joints two and four are clavate, the third cylindrical, and the last one conical, its tip rounded; the last two joints, as usual, bear each a small thumb. The rostrum reaches to the median coxæ.

Second generation, third stage.—In this stage they are still larger and stouter, and measure about 1.4 to 1.6^{mm} in length. The future

wing pads are now indicated by a rounded swelling each side of the pro and mesothorax. The antennæ are about twice as long as before, and reach, if laid backward, to the median coxæ. Joint three is longest, the two last ones somewhat shorter and subequal in length; joints one, three, and four are cylindrical; the second, which is slightly the shortest, is stoutest at the apex; the fifth is curved and tapering; the last two bear the usual thumb. In other respects they are very much like before.

Second generation, fourth or pupa stage.—In this stage they are still larger and stouter than before, and measure 2.4 to 2.6^{mm} in length and have now fully developed wing pads. They are reddish-brown to purplish-brown, the disc of the thorax more yellowish; eyes brown, the antennæ, legs, and wing pads whitish, the external margin of the latter blackish. The front of the head is now concave and the frontal tubercle minute. The antennæ are again much longer than before, or almost twice as long, with the division between joints three and five almost obliterated. The eyes are large and well developed.

FIG. 16.—*Hamamelistes spinosus:* Spring migrant—much enlarged (original).

Second generation, migrant or fifth stage (Fig. 16).—Early in July, or about a month and a half after hatching of the stem-mother, the earliest migrants are fully developed and commence leaving the galls and continue to issue till late in the fall. Having adjusted themselves, they start on their migratorial trip, during which they may frequently alight on the leaves of various plants, not alone for rest, but evidently for the purpose of determining the nature of the plant on which they may happen to be, though they will rarely deposit any larvæ until their unerring instinct finds the birches, the only plant suitable for the welfare of their progeny. Each of these migrants contains from thirty to forty or more larvæ, or only about one-seventh as many as the stem-mother. These migrants are rather larger than those of *Hormaphis hamamelidis* and measure between 1.8 and 2.4^{mm} in length, with an expanse of the wings of 4 to 6^{mm}. They are stoutly built and of a dark, purplish-brown color; the head, eyes, antennæ a dorso-lateral spot on the prothorax, thoracic lobes and sternal plate, black, and the legs dusky; apex of abdomen more

or less distinctly reddish; the wings are clear or faintly brownish, with the costal cell and stigma dusky and the veins blackish. They are slightly covered with a white and powdery secretion and, when not rubbed, have also two small tufts of a dense and white secretion on the scutellum, a similar tuft or patch each side on the thorax, and some fibers or flakes of secretion on the abdomen. Antennæ five-jointed, reaching only to the base of the wings; the two basal joints are short, with joint two almost globular; the third joint is longest, and as long as the remaining two combined; the last two are subequal in length, all three are densely and deeply annulated. There are between twenty-seven and thirty-two annulations on the third joint, twelve to fourteen on the fourth, and eleven to thirteen on the fifth joint. The head is broader than long and distinctly conical in front; eyes large. The legs are rather short and slender, the digitules highly developed. Tail small, transversely oval and knob-like, tuberculated, and hairy; the last segment is bilobed, and each of its lobes furnished with numerous, rather long hairs. The wings are large and broad and are carried flat on the back when at rest; the stigma is broadly lanceolate and somewhat broadest at the base of the stigmal vein. The venation is similar to that of *Hormaphis hamamelidis*, though the second discoidal vein joins the first much nearer its base than in the other species. The first discoidal of the posterior wings is rarely entire, and is usually represented by a small stump; sometimes it is wanting.

Third, or Coccidiform, generation.—After having fully matured the winged form leaves the witch-hazel galls and migrates to the leaves of birches to deposit their larvæ, which after a short time of feeding move to the twigs and branches and settle down close to a bud for their future transformation and for hibernation. Their growth appears to be very slow, and many of them perish before the approach of spring, so that usually but very few adult females will be found.

Third generation, first stage (Fig. 17).—The young larvæ of the migrant from witch-hazel are very peculiar, and resemble more closely, when seen on the twigs, the larvæ of a Lecaniid than those of an Aphid. They are about 0.4^{mm} in length, about twice as long as broad, oblong-ovate, and rather flat above. A slightly elevated rounded carina runs from the head to the end of the body, which is traversed by fine impressed lines, indicating the divisions of the body but failing to reach the lateral margin. There is also a rather deep fovea each side of the carina on the prothorax and a puncture each side of the carina on the other two segments of the thorax. The abdomen in comparison with the rest of the body is very small, or only about one-third or less of its length. The dorsum is densely granulated and more or less polished. The lateral edges are studded with about 30, and the front of the head with 16 to 18, short, truncated, and cylindrical secretory

tubercles, from each of which issues a transparent and colorless straight or slightly curved cylindrical waxy rod.

When first deposited these larvæ are of a reddish-brown color, the antennæ and legs paler, and the eyes dark purplish, which soon changes, however, excepting the under side of the body, to a beautiful, brilliant dark metallic blue or green, while others change to bluish-green, purplish, or to a brassy or coppery reflection. The antennæ are short, four-jointed, and inserted on the under side of the head. The first joint is shortest, stoutest, and slightly conical; joint two is somewhat longer and slightly clavate; the third is longest, cylindrical and about one-third longer than the second, while the last is a little shorter than the third and bears the usual sensorial thumb near the apex, the tip being surrounded with a few short hairs. The rostrum is stout and reaches beyond the median coxæ. Legs stout; the tarsal digitules are long, capitate and curved; those of the claws are much finer, straight, and only about half as long as the others. There are also two or three long and stout, backward curved bristles near the end of the hind tibiæ, and two similar ones on the hind tarsi.

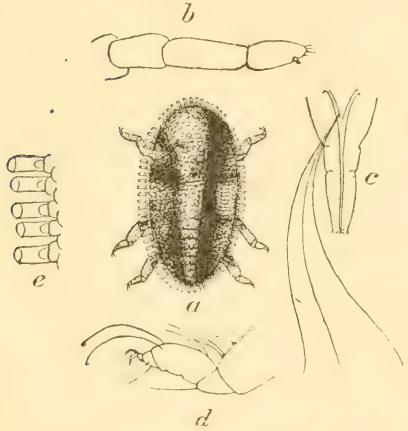

FIG. 17.—*Hamamelistes spinosus:* *a*, hibernating larva, third generation: *b*, antenna: *c*, rostrum; *d*, tarsus; *e*, lateral tubercles and waxy rods—much enlarged (original).

Third generation, second stage.—The larvæ in this stage are about 0.6^{mm} in length, broadly ōval and still rather flat; being but slightly convex on the thoracic segments and along the middle of the abdomen; the sutures dividing the various segments are quite plain, though they do not reach to the lateral margin. The surface of the body is now finely rugose and its lateral margin surrounded by a very short fringe of waxy secretion, issuing from closely set secretory tubercles. The antennæ are now much shorter than before and only three-jointed; the two basal joints are short and subequal in length, while the third is about as long as the two basal joints together, slightly tapering and truncate at the tip. The rostrum has become shorter and reaches only to the median coxæ. The legs are also shorter, while the anterior and median legs have lost their tarsi, which sometimes are indicated by a minute, knob-like swelling; the posterior pair of tarsi are still present, though rather short, irregular in outline and have lost the claws; the digitules are still present, though rather short and fine. The color of the insect is now of a dull black or dark brown.

Third generation, third stage.—In this stage they look very much

like before, except that they are much broader and about 0.8mm in length: the surface of the body is now densely and finely rugose, and the sutures between the segments have become deep and broad; there is also a depressed subdorsal line around the body; the tail is broad, semicircular, more distinct than before, and furnished with 4 to 6 hairs. The antennæ are still three-jointed, the second joint being much the longest and cylindrical and the third joint minute or rudimentary. They are dark brown or black and greasy looking.

Third generation; adult female; fourth stage (Fig. 18).—The adult female of this generation is broadly oval and measures 1.2 to 1.4mm in length and 1 to 1.2mm in diameter. After casting the last skin they are deep black, convex, and densely and coarsely rugose, with three rather prominent, short, and rounded transverse ridges about the middle of the body, and irregular rows of pits and depressions each side of the median line. The edge of the body is closely lined with about 120 short, secretory tubercles and about 14 similar ones along the edge of the tail, producing a continuous, but very narrow, waxy fringe around the body. The dorsal surface is at first bare, but soon becomes covered with a whitish, powdery secretion, which gives to the insect a moldy appearance; this changes gradually into scattered, delicate, waxy flakes or scales, which, toward the approach of spring, form a solid and continuous waxy covering, most dense or solid along the sides and the end of the body, giving them a dark silvery-gray appearance, on account of which they assume a remarkable resemblance to certain species of the Lecaniid genus *Ctenochiton*. Advancing to maternity, the ventral side of the body becomes very much inflated and assumes a box-like appearance, as in some Aleurodids, and is covered with a powdery secretion. The antennæ are now very small and rudimentary and apparently but two jointed, though there may be three, which, however, could not be ascertained with certainty on account of the very dark color and the coarse rugosity of the body. The legs are as in the previous stage, except that the hind tarsi are only about half as long as before.

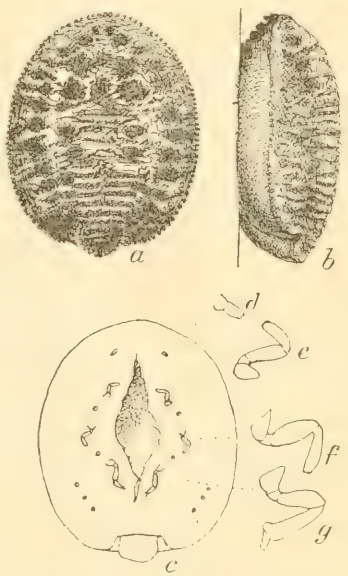

FIG. 18.—*Hamamelistes spinosus: a*, adult female, third generation, dorsal view; *b*, lateral view; *c*, ventral view; *d*, antenna; *e*, *f*, *g*, legs—much enlarged (original).

Pseudo-galls, or corrugations (Fig. 19).—About the middle of April, or just about the time of bursting of the leaf-buds of the

birches, the coccidiform, or hibernating females, have attained their full development and begin at once their duty of reproduction. The young larvæ soon after having been deposited are directed by their inherited instinct, to move at once to the young and tender leaflets which are just bursting forth, and settle on the under side in the folds or plications between the transverse veins. The continuous irritation produced by the sucking of the insects causes the edges of the young leaves to curve down, while at the same time the upper surface of the leaves between the veins commences to bulge out and gradually forms

FIG. 19.—*Hamamelistes spinosus:* Pseudo-galls, or corrugations, on leaves of birch—natural size (original).

rounded ridges, or corrugations, while the folds on the under side gradually close up. The thus formed pseudo-galls, offer ample room for the gall-makers and their progeny. These corrugations or folds acquire a reddish-brown shade which soon changes to a beautiful reddish or crimson color. The growth of the young insect is rapid, keeps pace with the growth of the infested leaves and reaches full development by the end of April or early in May, or about twenty days from the time they were born and commence at once to reproduce their kind, which frequently become so numerous as to fill these pocket-like folds to their utmost capacity. In favorable years the insects

are apt to become extremely numerous, so as to injure even large trees very seriously, causing the infested leaves to turn gradually brown and to drop after most of the insects have left. This injury to the foliage of badly infested trees or shrubs, as a rule, is very severe on the branches, many of which gradually dry up and die, which injury, if continued for a number of years, will kill the trees. The development of the second generation of the gall-inhabiting insects, which eventually become winged, is also rapid, to enable them to attain full development before the leaves commence to drop and to be ready for return migration to the witch-hazel early in June, to give birth to the final or sexed generation, to complete the cycle of existence of the species. This is the generation described by Mr. O. W. Oestlund in his "Synopsis of Aphidæ of Minnesota," under the name of *Hormaphis papyraceæ*.

Fourth generation, first stage (Fig. 20).—The general appearance of the leaf-corrugating generation has so completely changed as to bear no resemblance whatever to the previous coccidiform generation; so much so as to render it impossible to detect their affinity or their close relationship except by continued and close observation; which I have been so fortunate as to trace without the shadow of a doubt.

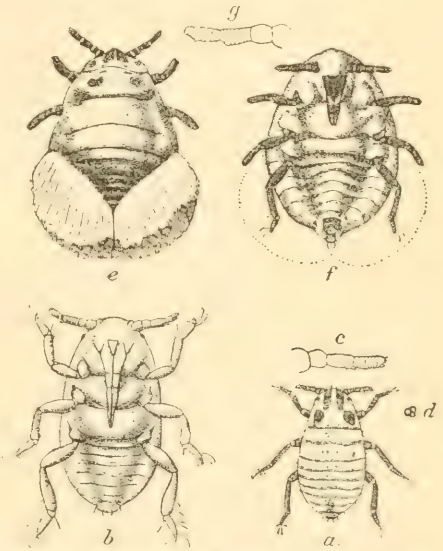

FIG. 20.—*Hamamelistes spinosus: a*, Young larva, fourth generation, dorsal view; *b*, ventral view; *c*, antenna; *d*, eye; *e*, adult female, dorsal view; *f*, ventral view; *g*, antenna—much enlarged (original).

The young larvæ when first deposited are of an orange color, but soon change to yellowish-brown; marked with two broad and faintly dusky stripes on the head, which extend to the prothorax. The eyes are purplish, with three colorless ocelli. Antennæ and legs dusky. They are elongate-oval, slightly convex, distinctly segmented, and 0.3 to 0.5^{mm} in length. The head is broader than long and semicircular in front, where it bears four short bristles arising from small tubercles; two similar bristles are each side of the thoracic, one each side of the abdominal segments, and four along the edge of the broad and semicircular tail. There appears to be also a transverse row of four short bristles on the thoracic segments and two, medio-dorsally, on the abdominal segments. The antennæ are four-jointed; the two basal joints short and subequal in length; the two last joints long

and also subequal in length; joints one to three are cylindrical or slightly stoutest at the apex; the fourth being elongated oval. The third and fourth are slightly annulated, each bearing a small and movable thumb. The legs are long and stout, with the hairs and digitules very similar to those of previous generations. The rostrum is stout and reaches to the posterior coxæ.

Fourth generation; second stage.—In this stage they measure between 0.6 to 0.9mm in length and are broadly ovoid, broadest across the thorax and gently tapering toward the end of the body. They are of a reddish color, marked with two large and triangular, dusky or black spots near the anterior margin of the head, two to four small dusky spots between the eyes and a dusky, depressed subdorsal spot each side on the prothorax. Eyes, antennæ and legs black, the rostrum dusky. The body is covered with a white and powdery secretion, most profuse along the middle. There has now also appeared a short and dense brush of a white and glistening secretion each side near the end of the body. The rostrum is shorter than before and reaches to the median coxæ; antennæ four-jointed as before; the two basal joints, as usual, short, subequal in length and slightly stoutest at the apex; the third joint is longest and cylindrical, the fourth but slightly shorter and both bearing a short thumb near the apex; there is a rather long bristle near the apex of the two basal joints and a number of small hairs at the apex of the fourth. The anterior and median tarsi have been lost or are represented by a minute rounded stump. The hind tarsi are present, but have lost the claws; bristles and digitules of hind tibiæ and tarsi are present. The hairs of the head and body are now much longer and stouter than in the first stage.

Fourth generation; third stage.—In this stage they are almost identical with those in the previous stage, though they are now almost globular, 1mm. in length and of a dark-greenish or brownish-green color, marked with two large dusky spots on the head, reaching beyond the eyes. The powdery secretion forms now a distinct white line along the middle of the back. The rostrum has grown still shorter than before; the tail is broad, provided with six hairs and densely covered with rows of minute and sharp spines.

Fourth generation; adult female, or fourth stage.—The adult female of this generation is very convex, almost globular, 1.2 to 1.6mm long and 1 to 1.2mm in diameter. They are at first dark brownish-red, changing gradually to dark yellowish-green, and finally to a purplish color; the front of the head, two small dots on the prothorax, a band at base of the tail, tip of tail and of the two lobes of the last segment, eyes, antennæ, legs, and rostrum, all black. They are slightly dusted with powdery secretion as before, and bear also a short brush of secretion along both sides of the abdomen. The segmentation of the body is quite distinct; there is also a rather deep dorso-lateral groove

or furrow around the entire body, which, with the lateral margin, forms a prominent, rounded ridge. The antennæ are identical with those of the previous stage, except that they are somewhat longer. The anterior and middle tarsi are either wanting or are sometimes represented by a minute, squarish stump, which occasionally bears at its external angle two rather stout, outward-curved hooklets, evidently the representatives of claws, while the hind tarsi, in the majority of cases, are again quite normal; some specimens have one or two perfect claws, indications of claws, or none whatever; the tarsal digitules of the posterior legs may be well developed, rudimentary, or wanting. The mature insect may, however, be always recognized by

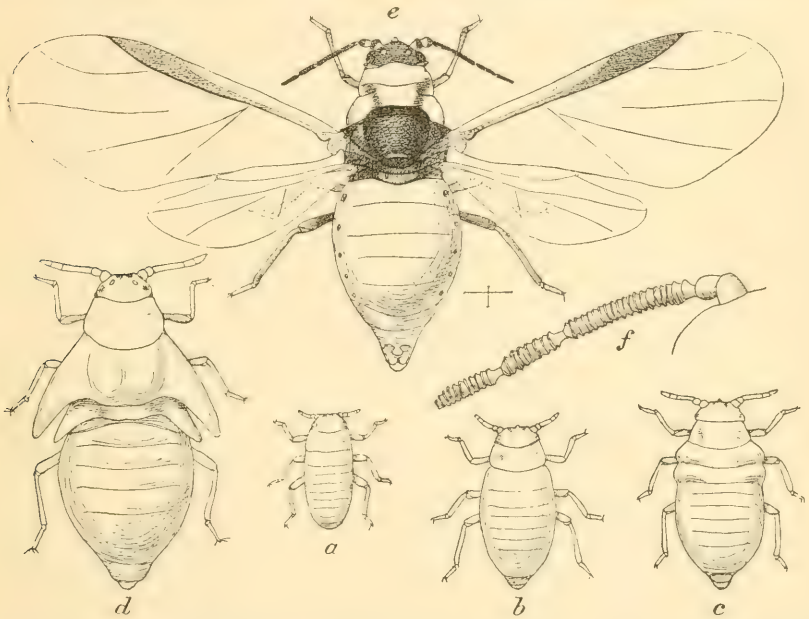

FIG. 21.—*Hamamelistes spinosus: a*, young larva, first stage, fifth generation; *b*, larva, second stage; *c*, prepupa, third stage; *d*, pupa; *e*, return migrant; *f*, antenna—much enlarged (original).

the formation of the last abdominal segment and the shape of the tail; in the immature specimens the tail is short, very broad, being either broadly arcuate or with an obtuse angle medially, while the last abdominal segment is semicircular and entire. In the adult female, however, the tail is small, transversely oval, knob-like, and bears two bristles, the last segment being strongly bilobed, each lobe bearing ten or more long hairs. The rostrum is short and reaches but slightly beyond the anterior coxæ. The hairs of the head and body are similar to those in previous stages, except that they are longer and stouter.

Fifth or migratory generation; first stage (Fig. 21).—Early in May the leaf-corrugating females or fourth generation of the series are fully matured and commence their reproductive functions. The

young larvæ of this generation are at first pale yellowish, but as they grow in size become much darker. The head is dusky; antennæ, legs, and rostrum darker, and the eyes black or purplish black. They are dusted with a mealy secretion, and soon acquire a short brush of white secretion along each side of the abdomen. They are about 0.6^{mm} in length, much elongated, and almost three times as long as broad, with the sides nearly parallel. The front of the head is almost straight and provided at the middle with a prominent, rounded tubercle. The posterior end of the body is rounded. The antennæ are four-jointed, rather stout, and slightly curved inward; joint two is slightly the shortest, the first stoutest; both bear a bristle near the apex; joints three and four are longer and subequal in length; the third is cylindrical and bears a small thumb near the apex; the last joint is slightly curved, tapering, and faintly annulated, bearing the usual thumb and several short, stiff bristles around the apex; they reach about as far back as the first coxæ. The rostrum is stout and reaches beyond the median coxæ. The legs are long and stout, with the tarsi and claws highly developed. There is a rather long bristle near the end of the femora; two hairs or bristles near the end and one about the middle of the tibiæ, those of the posterior tibiæ being much the longest; also one or two shorter ones on the tarsi. The tarsal digitules are very long and capitate; those of the claws appear to be wanting. The body is provided with four dorsal rows of small tubercles, each bearing a short and stout hair. Similar tubercles, and hairs are also present along the sides of the body and front of the head.

Fifth generation; second stage.—In this stage they resemble still very much the young larvæ, though they measure now already 1^{mm} in length and are of a more elongate shape. They are, as before, covered with powdery secretion and provided with a lateral brush. The head is almost straight and has lost the frontal tubercle; the rostrum is shorter and reaches between the anterior and median coxæ. The antennæ are now five-jointed, very stout and distinctly curved inward. The two basal joints are short, each bearing a bristle near the apex; the third and fourth are nearly subequal, with the third somewhat the longest; the fifth is longest of all, curved and tapering, bearing a number of spine-like hairs around the apex. The last two joints bear the usual thumbs. All the tarsi, claws, and digitules are present. The hairs of the body and head are now much longer and stouter than in the first stage.

Fifth generation; third stage.—In this stage they resemble still those of the second, though they are larger and measure about 1.2 to 1.4^{mm} in length. The future wing-pads are now indicated by rounded swellings at the sides of the meso- and metathoracic segments. Tarsi and claws present, as before. The antennæ are now about one-fourth longer than in the second stage, the third and fourth joints being subequal and longer than the others; in other respects they are as before.

Fifth generation; fourth or pupa stage.—The fully developed pupæ

vary to some extent in size, measuring from 1 to 1.6mm in length. They are of a reddish or purplish-red color, with the prothorax somewhat the darkest, the head and rest of the thorax palest, the shoulders whitish or yellowish. Eyes brown and the ocelli red. Antennæ, legs, wing-pads, and rostrum pale dusky; the sutures between the antennal joints white and the external edge of the wing-pads blackish. All are covered with a dense, straight and hair-like, white and glistening secretion, which is most dense and brush-like along each side of the abdomen; this secretion is apt, however, to be easily detached by the movements of the insects within the folds. The antennæ are much longer than in the preceding stages, and if directed backward would reach to or beyond the base of the wing-pads. The third joint is much the longest and almost as long as the two last joints combined; the fourth and fifth are subequal in length; the sensorial thumb of each is minute; the third and fourth are cylindrical and the last one slightly tapering, with the usual hairs at the apex. In other respects they are similar to those of previous stages.

Fifth generation; migrant, or fifth stage.—The winged form or return migrant is much smaller than those leaving the witch-hazel galls, being only about one-half their size. Length of body, 1.6mm, and expanse of wings about 5mm. They are dark reddish, the abdomen frequently with a purplish tinge or sometimes greenish-brown. Head, antennæ, an oblique or triangular depression each side of the prothorax, thoracic lobes, sternal plate, and tarsi, black; the legs dusky. Wings faintly dusky, the subcosta and stigma dusky, the costal cell somewhat paler; veins black. Antennæ five-jointed; the second joint is almost globular; the third is much the longest; the other two subequal in length and together somewhat longer than the third; all three are strongly and deeply annulated, the number of annulations in each varying more or less; those of the third joint vary between 20 and 30; in the fourth between 10 to 13, and in the fifth between 14 and 15, though in some specimens there may be but a very few and widely separated annulations on the last joint. The legs are normal and the digitules of the tarsi, as well as the claws, well developed. The head, including the eyes, is about twice as broad as long and more or less distinctly conical in front. The tail is knob-like, densely covered with minute spines, and bears two long and about six smaller bristles. The last abdominal segment is deeply bilobed and densely spinous, and bears in addition a number of bristles.

Fifth generation; accessory, apterous female.—In the folds or corrugations, in company of the winged form, are frequently found apterous females, belonging to the fifth generation, which are destined to produce an additional or intermediate migratory generation. The economy of these apterous females and additional migratory generations remains rather obscure.

These accessory females are of a dirty brownish color, and densely

covered with a short, flocculent secretion, giving them the appearance of mealy bugs, and measure about 1.8mm in length by about 1mm in diameter. The front of the head is straight, the tail knob-like, the last segment deeply bilobed and provided with bristles and minute spines as in the migratory form. The antennæ are also five-jointed, though only about half as long as those of the migrant. The two basal joints, as usual, are short and stout, each bearing a bristle; the last is somewhat the longest; the third and fourth slightly shorter, subequal in length, and all three slightly annulated. In other respects they resemble the previous stages.

Sixth, or sexual generation.—From early in June till about the middle of the month the migratory generation, bred on the birches, attains its full development and migrates back to the witch-hazel to consign to it the final or sexed generation. Large numbers of these migrants may then frequently be seen on the under side of the leaves of this shrub, in the neighborhood of the birches, and with them numerous larvæ, scattered over the surface of the leaves, particularly along the midrib and the veins. On one of the leaves examined 61 living and 20 dead larvæ were counted, and on another leaf 35 living and a considerable number of dead larvæ, which tends to indicate that only about one-third, or even a smaller percentage of all the larvæ, are able to reach maturity, and that even a much smaller number of the winter eggs may survive and hatch the following spring. The sexual generation develops also rather rapidly and reaches maturity within two or three weeks, when, toward the middle or end of June, after copulation has taken place, the females forsake the leaves and betake themselves to the twigs for the purpose of depositing their winter eggs in the immediate neighborhood of the dormant flower buds, which, in the spring following, start to develop just at the time that the eggs are hatching.

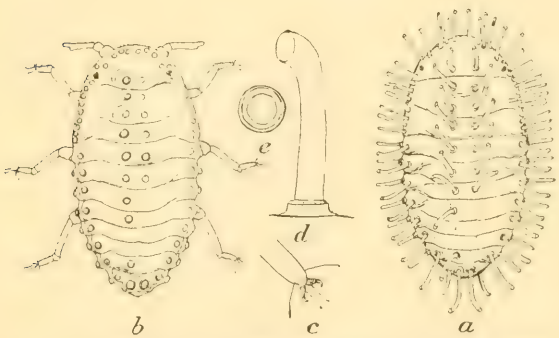

FIG. 22.—*Hamamelistes spinosus: a*, young larva, sixth or sexual generation, dorsal view; *b*, denuded, showing arrangement of pores; *c*, tarsus; *d*, lateral tubercle and waxy rod; *e*, apex of lateral tubercle—much enlarged (original).

Sixth generation, first stage (Fig. 22).—The young larvæ of the sexual generation are of a very pale yellowish-white color, with the eyes black and minute. They are about 0.5mm long, oval or slightly broadest across the thorax. There are generally about twelve short and stout secretory tubercles along the front of the head, two or three in front of the eyes, and two near the posterior margin between the

eyes; there are also four medio-dorsal tubercles placed in a square, and three to four along the lateral margin of the prothorax; two tubercles medio-dorsally and three to four each side of the meso- and metathorax; one or two median ones on the three or four basal segments of the abdomen and sometimes one on the remaining segments; there is also one dorso- and one ventro-lateral tubercle on each abdominal segment, the last segment bearing from four to six tubercles along its posterior margin, from each of which issues a white and iridescent, truncated, and curved waxy rod. The head is transversely and deeply concave in front of the eyes. Antennæ short and four-jointed. The two basal joints are short, each bearing a short bristle; the other two are longer and subequal in length; both are slightly annulated, and both bear a small, sensorial thumb; the spur of the

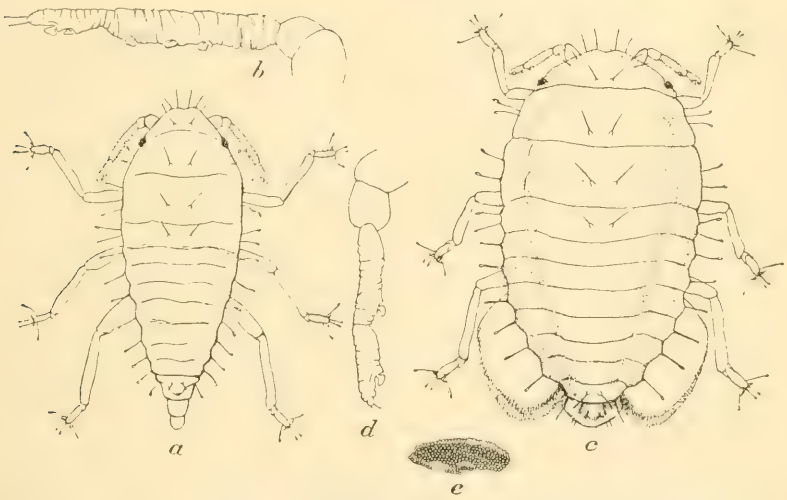

FIG. 23.—*Hamamelistes spinosus: a*, male, dorsal view; *b*, antenna; *c*, female, dorsal view; *d*, antenna; *e*, ventro-lateral secretory gland—much enlarged (original).

last joint is short and stout and bears two or three small hairs at the apex. The rostrum is stout and reaches beyond the posterior coxæ. The legs are long and stout, with their tarsi, claws, digitules, and bristles highly developed. Male and female larvæ are difficult to distinguish from each other.

Sixth generation, second to fourth stages.—In these stages they resemble still those of the first stage, except that they grow gradually larger, that the antennæ increase in length, and that the two last joints tend to become more or less distinctly fused, the division between them being, as a rule, indicated by a very minute knob.

Sixth generation, mature female (Fig. 23).—The mature females are of the same pale color as before and about 1^{mm} in length, they are broadly oval and have lost all traces of the secretory tubercles, but have acquired instead of them rather long and stout bristles, some of

which are slightly capitate; eight of these bristles may be observed along the front of the head; two between the eyes; two medio-dorsal ones on the thoracic segments and two in front of the tail; also two lateral bristles on the thoracic and one each side of the abdominal segments. There is now also a large ventro-lateral poriferous plate or gland each side on the ventral side of the abdomen, covering segments 4 to 6, from which a dense mass of fine white and glistening threads of waxy secretion issues, which curves up the sides of the body, so as to form a dense brush or rosette, the material of which is afterwards used by the female, while in the act of ovipositing, to cover the sticky eggs with the aid of its hind tarsi to disguise them so as to conform with the pubescence of the twigs and buds. This habit resembles in this respect that of the sexual females of *Phyllaphis fagi* and certain other species, which have the same habit of covering their eggs. The antennæ are four-jointed, though sometimes the fourth joint may be rudimentary or wanting; the third joint is much the longest and about twice the length of the fourth; both are more or less distinctly or sharply serrate and both bear the usual movable thumbs. The rostrum is highly developed and reaches to the median coxæ. The legs, claws, and digitules are well developed and similar to those of previous stages. The tail is small, knob-like, transversely wrinkled, beset with minute spines, and bears two bristles. They contain from one to five rather large eggs, which fill the greater part of the body.

Sixth generation, male.—The mature male is very small, or but slightly larger than the young larvæ and only about one-third the size of the mature female. It measures about 0.4^{mm} in length, and is comparatively very slender, being broadest across the mesothorax, tapering gradually toward the end of the body. The head is broadly triangular, with the apex slightly concave. The eyes are prominent and reddish-black. The rostrum is stout, highly developed, and reaches to the median coxæ. Antennæ slender, four-jointed, and reach when laid backward to the anterior femora. The third joint is much the longest and about twice the length of the fourth. Both are rather sharply and densely serrate. Joint 3 is cylindrical and bears from two to three movable, sensorial thumbs, and the fourth joint one or two at the base of the short spur and two or three small hairs at the apex. The legs are more slender and comparatively longer than those of the female; tail small and knob-like. All of the pores have disappeared. The hairs or bristles of the head and body are as in the female. The male is extremely active after attaining its full development and runs briskly about over the surface of the leaves. On account of its smallness and general resemblance to the larva, it is extremely difficult to distinguish it from female larva.

TECHNICAL SERIES, No. 10.

U. S. DEPARTMENT OF AGRICULTURE,

BUREAU OF ENTOMOLOGY.

L. O. HOWARD, Entomologist.

THE SOCIAL ORGANIZATION AND BREEDING HABITS OF THE COTTON-PROTECTING KELEP OF GUATEMALA.

BY

O. F. COOK,

Bionomist in Charge of Investigations in Agricultural Economy of Tropical and Subtropical Plants.

WASHINGTON:

GOVERNMENT PRINTING OFFICE.

1905.

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1905.

LETTER OF TRANSMITTAL.

U. S. Department of Agriculture,
Bureau of Entomology,
Washington, D. C., April 22, 1905.

Sir: I have the honor to transmit herewith a paper on the social organization and breeding habits of the cotton-protecting kelep of Guatemala (*Ectatomma tuberculatum* Ol.), by Mr. O. F. Cook, Bionomist in Charge of Investigations in Agricultural Economy of Tropical and Subtropical Plants, Bureau of Plant Industry, and temporarily on duty in this Bureau for the purpose of continuing the investigations of this particular insect, whose cotton-protecting habits he was the first to describe. This report contains evidence to show that the breeding habits of the insect in question, especially its methods of founding new colonies, are essentially different from those of typical ants (family Formicidæ) and resemble in important particulars those of the domestic honeybee. The possession of this type of social organization will, in Mr. Cook's judgment, greatly facilitate the establishment of the kelep in the cotton fields of the South if the insect should be able to withstand the change of climate and other natural conditions. I recommend that this paper be published as Technical Series No. 10. Another bulletin dealing more fully with the details of the life history of the species is being prepared and will be fully illustrated.

Respectfully,

L. O. Howard,
Entomologist and Chief of Bureau.

Hon. James Wilson,
Secretary of Agriculture.

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THE SOCIAL ORGANIZATION AND BREEDING HABITS OF THE COTTON-PROTECTING KELEP OF GUATEMALA.

INTRODUCTION.

In preceding reports treating of the kelep as an enemy of the cotton boll weevil the distinctness of its behavior from that of the true ants has been noted. To avoid in some measure the misapprehension likely to be caused by calling it an ant it seemed desirable to introduce with the insect its distinctive Indian name, *kelep*. In the minds of the natives of Guatemala, the kelep is not a kind of ant, but an independent animal not to be associated with ants. The more we learn about it the more this aboriginal opinion appears justified, not alone because the kelep is a beneficial insect, but because it has a different mode of existence and a different place in the economy of nature.

The popular classification of the social Hymenoptera recognizes three types—the ants, the bees, and the wasps, the ants being distinguished from the others by the absence of wings. The kelep falls, however, into none of these groups. To call it a wasp or a bee would not misrepresent the practical facts more than to call it an ant. In reality the kelep represents a fourth category of social Hymenoptera, as distinct from the other three as they are from each other. Authorities on the classification of the Hymenoptera have admitted a rather close affinity between the wasps and the ants, but the kelep differs from both of these groups and approaches the bees in important respects, and especially in those which affect the question of its domestication and utilization in agriculture.

It was naturally supposed at first that the kelep would have the same habits as the true ants which have been associated with it as members of the same family or subfamily, but the differences were greatly underestimated. If the Hymenoptera were classified by a taxonomic system consistent with that applied to the higher animals, the kelep would need to be recognized as the type of a new and distinct family. It is, moreover, the first member of its family of which the habits have become known. Under such circumstances it was quite impossible, obviously, to determine in advance whether its habits and instincts would permit its colonization in the United States and its use in agriculture.

The fundamental difference between the ants and the kelep, and that in which the latter resembles the honey bee, lies in the methods of swarming. Among the bees and the keleps swarming results

directly in the formation of new colonies, but the swarming of the ants is a distinct biological phenomenon having for its object cross-fertilization. The kelep is completely socialized, like the honeybee, while the ant is not. The keleps and the honeybees live only in communities, while the ants at one stage of their life history leave the nest and meet the vicissitudes of independent existence as solitary individuals, like the nonsocial insects. The social organization of the kelep represents a line of development distinct from that of the ants, and shows a relationship with the parasitic and predaceous wasps rather than with the true ants.

SWARMING AND OTHER TIME SPECIALIZATIONS.

The swarming of the ants is one of the many interesting phenomena which might be grouped under such an expression as biological synchronism. Species are organisms, or at least organizations, and in some of them there is manifested a simultaneity or time coördination of the numerous members corresponding to the orderly development of the cells of which the body of the individual is built. A flock of birds or a school of fish, with the individuals separated at equal distances and executing all their movements in exact unison, is a striking example of such synchronism, but other no less mysterious adjustments are necessary to enable animals and plants to keep so exactly the annual appointments by which the interbreeding of the members of the species is maintained. The climatic vicissitudes of temperate regions make complete simultaneity difficult, and have led us to ascribe the annual recurrence of events to the change of seasons rather than to recondite internal causes. The thirteen-year and seventeen-year trysts kept by the periodical cicadas over wide regions show, however, that more than sum totals of heat, cold, and food are involved, even in temperate climates.

Under the equable conditions of tropical existence, where the seasonal explanation entirely fails, there are biological events which might seem to show that plants and animals not only have drill-masters but time locks. Some of the Asiatic bamboos grow for thirty years or more by vegetative increase alone without producing flowers or fruit, and then all the members of the stock blossom, bear seeds, and die together, without reference to the age, place, or condition of the individual plants which may have been propagated from cuttings and carried to remote parts of the earth.

ANNUAL MATING CONCOURSES OF TERMITES AND TRUE ANTS.

Nests of West African "white ants," or termites, are crowded for weeks with winged individuals, but not one is to be found outside until some moist afternoon or evening, when the young sexual in-

sects emerge from all the nests of the species in the same hour. The air is filled as by snowflakes or a plague of locusts. Lights attract the flying insects, and are smothered under heaps of toasted termites. The insectivorous birds and reptiles gorge themselves to repletion. By the next morning the detached wings have been blown together in windrows, and nothing more is to be seen of that particular species for another year except by digging into their nests or galleries.

Probably not one pair of termites out of many thousands survive to become the parents of a new colony, but the purpose of the sacrifice is accomplished if these have secured the interbreeding necessary to maintain the incredible fecundity by which the termite queen furnishes the population of a community to be enumerated in millions. The mothers of such colonies have been seen to lay from 40 to 60 eggs per minute.

The true ants belong, of course, to an entirely different order of insects, and their social organization and swarming habits have been attained quite independently. Nevertheless some of them, and especially the families best known to entomologists, have a domestic economy and a morphological diversification of the members of the colony surprisingly paralleled to that of the termites, including the habit of annual mating concourses of sexual adults. There are in many species, both of ants and of termites, not only the two normal sexes and the sterile workers, but some of the last are further specialized in structure, instinct, and social duties as soldiers, foremen, nurses, etc. A family of American ants (*Cryptoceridæ*) also resembles a genus of African termites in maintaining an extensive and highly specialized system of fungus gardens.[a] Other ants have domesticated plant lice, mealy bugs, and leaf hoppers for the sake of the honey dew secreted by these animals, which are herded,

[a] With these fungus-cultivating ants and termites, at least, it would seem that a new colony can scarcely be founded by a pair of sexual termites or by a single fecundated female ant unless they carry their domesticated fungus with them. It is possible, however, that in both cases the newly mated insects are adopted and set up in housekeeping and farming by workers of their own species, who bring "spawn" of the fungi from the older colony with which they are in communication. This might the more readily happen because long subterranean galleries are a prominent feature of the architecture of the fungus-growing insects, both ants and termites.

The keleps, indeed, may be said to have taken a step toward the domestication of the cotton plant. They have at least adopted it, and show an instinctive interest and attraction for it in preference to other plants. That this also extends to a special animosity for the boll weevil as an enemy of the cotton is not, perhaps, to be claimed, but the habit of living on the cotton plant has resulted, no doubt, in giving the keleps a special familiarity with the boll weevils and a special skill in capturing and stinging them.

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pastured, and cleaned with as much care as modern dairy cattle." Some ants have also a highly developed slave-making instinct, and undertake regular raids on the nests of other species to capture their young and carry them away to be brought up in servitude.

It would seem, therefore, that in the highest members of both groups of social insects the chief purpose served by this simultaneous emergence, or "swarming," as it is commonly called, is interbreeding, or cross-fertilization, rather than the founding of new colonies in more distant localities, as hitherto supposed. This may explain why the species of these insects have achieved nothing very remarkable in the way of geographical distribution, in spite of the immense fecundity of their females. A single individual ant or a pair of termites might be able to establish a *colony* in a new locality, but the lack of opportunities for cross-fertilization might prevent the perpetuation and further extension of the *species*, which could increase its range only by gradual, continuous expansion.

BREEDING HABITS OF THE KELEP.

With such instances in mind it becomes easier to appreciate the fact that the breeding habits of the kelep differ notably from those of the termites and termite-like ants, and approach those of the domestic honeybee. Although the actual migration has not been observed, there are strong indications that, instead of emitting annual broods of sexual individuals and founding colonies by means of solitary fecundated females, the kelep communities simply subdivide after the fashion of the bees, or in a still more practical and business-like manner, the problem of cross-fertilization having been solved in another

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"The extreme development of the pastoral instinct is to be found in an ant which takes care of the eggs of its plant-lice cattle through the winter.

"It is not merely that the ants milk them, defend them from attack, sometimes protect them by earthen inclosures from too great summer heat, but over and above all this they collect the eggs in autumn, keep them through the winter, and plant them out on their proper plant in the spring. Some of the root aphides may always be found in ants' nests, but I was much puzzled years ago by finding in ants' nests some black eggs which obviously were not those of ants. Eventually I ascertained that they belonged to a species of aphis, which lives on the leaves and leaf stalks of plants.

"These eggs are laid early in October on the food plant of the insect. They are of no direct use to the ants, yet they are not left where they are laid, exposed to the severity of the weather and to innumerable dangers, but are brought into their nests by the ants and tended by them with the utmost care through the long winter months until the following March, when the young ones are brought out and again placed on the young shoots of the daisy. This seems to be a most remarkable case of prudence. Our ants may not, perhaps, lay up food for the winter, but they do more, for they keep during six months the eggs which will enable them to procure food during the following summer, a case of prudence unexampled in the animal kingdom."—Avebury, 1905, The Open Court, 19: 190.

way.[a] The data which seem to support this conclusion are briefly summarized in the following paragraphs.

SIZE OF THE KELEP COLONIES.

The colonies, while very variable in size, range between 100 and 400 workers, and thus are of the same order of magnitude, instead of forming a series from solitary queens to communities of thousands or millions, as among the true ants and termites. Out of nearly 150 nests which have been explored only 3 or 4 had less than 100 workers. This fact alone was sufficient to place the kelep in strong contrast with the leaf-cutting ants, which are such conspicuous members of the insect fauna of Central America. The colonies of the leaf cutters contain enormous numbers of individuals, hundreds of thousands, or millions, perhaps; and yet the young queens begin alone. The small burrows of several such were found while kelep nests were being opened, the annual mating flight of the leaf cutters having taken place only a short time before.[b]

Most of the colonies brought from Guatemala in the first importation were, as it now appears, mere fragments of normal communities, containing from 20 to 50 workers. The jars obtainable in Guatemala for use as cages were very small, and it was feared that overcrowding would be detrimental. It was supposed, too, on the analogy of the ants, that the colonies would readily replenish their numbers if conditions should prove favorable in Texas.

In the Texas experiments, however, it became apparent at once that in courage and general activity the behavior of the large colonies was very different from that of the small ones, a fact which the character of the social organization permits us to appreciate more fully than before. When permitted to do so the larger colonies generally moved with promptness out of the cages and established themselves

[a] After the above was written Mr. McLachlan reported from Victoria, Tex., that there had been an increase in the number of colonies in two kelep settlements in the cotton field near that place. One wire-netting cage which had been supplied with four imported colonies was found to contain six colonies; another had seven colonies, though only five had been left in it. Before leaving Texas in October, I had noticed numerous young keleps in these cages, but had observed no addition to the original number of colonies.

[b] It seems to be true, as the Indians say, that the leaf cutters are unable to establish themselves in territory occupied by the keleps. Presumably the keleps kill the leaf-cutter workers as soon as they come out of the ground, and the queen, being thus unable to raise a family to forage for her, soon starves to death. If there is a nest of leaf cutters near enough to a cotton field to make a raid upon it, the Indians protect it by a fence of tough leaves of the plant called *mosh* (Calathæa). The same leaves are used by the black "Caribs" of Livingston for lining the waterproof baskets which they weave from the climbing spiny palm (Desmoncus).

in new burrows of their own digging. Small colonies often refused to leave the cages. Large colonies took boll weevils as soon as offered, stung them, and carried them back into the nest to feed the young, while some of the less populous communities showed none of the hunting instinct and would tolerate the boll weevils for hours or even for days.

It has been observed, too, by many students of bees and other social insects, that colonies too much reduced in numbers may become listless and discouraged and fail to manifest their normal activities and instincts. To this rule the kelep is no exception; nevertheless, even in very small numbers or as solitary individuals they do not lose entirely their rational demeanor. This self-possession is probably a consequence of the habit of the keleps to spend considerable periods outside their nests patrolling the cotton plants, or standing motionless, waiting for boll weevils or other insect prey. The temperamental contrast with the honeybee in this respect is very striking.

> The bee is above all, and even to a greater extent than the ant, a creature of the crowd. She can live only in the midst of a multitude * * * Isolate her, and, however abundant the food or favorable the temperature, she will expire in a few days, not of hunger or cold, but of loneliness. From the crowd, from the city, she derives an invisible aliment that is as necessary to her as honey.[a]

POPULATION OF KELEP NEST THE SAME THROUGHOUT THE SEASON.

The numbers of the insects and young and other conditions inside the nests of the keleps in Guatemala have been found to be the same after an interval of over six months. The first exploration was made at the end of the dry season, in April, May, and June; the second at the end of the rainy season, in November and December. Numerous captive colonies also have been under continuous observation throughout the same period. No indication has been detected of any seasonal difference of habits, nor is it necessary to suppose that anything different takes place in order to explain the domestic economy and breeding habits of the species.[b]

ONLY ONE TYPE OF WORKER.

The workers are all of the same form and of nearly the same size, with no indications of the existence of a first brood of very small individuals. In some colonies the workers average appreciably larger than in others, but there is no such diversity as among the true

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[a] Maeterlinck, M., 1901, The Life of the Bee, 30.

[b] While this report has been awaiting publication the period of observation in Guatemala has been extended through the remainder of the winter and spring months. The maximum of breeding activity appears to fall in the dry season, at the end of the cotton-growing period, in March and April. Nests excavated by Mr. G. P. Goll contained in some instances over twice as many cocoons as adult insects. In other seasons this proportion is usually reversed.

ants. If colonies were established by solitary fecundated females, as among the true ants, some of the nests would have shown examples of the undersized workers, of which the first brood raised by the queen ant is regularly composed.

It is now a well-established fact that every ant colony is founded by a single fertilized female, or queen. The insect loses her wings and buries herself in a small cavity in the soil or wood that is to form the future nest. After entering the cavity she usually closes the opening so that she is completely shut off from the outside world. She deposits, at the expiration of a certain time, a number of eggs, and when these hatch as larvæ she does not go abroad in quest of food, but feeds her offspring with substances regurgitated from her own body. These substances are ultimately derived from the fat body, a store of nutriment accumulated during her life in the maternal nest, which she forsook to take the nuptial flight. Of course, the insect must derive her own nourishment from the same internal source, and as, in all ants, the development of the young extends over a considerable period of time, it follows that the larvæ are of necessity poorly fed, and after pupation hatched as dwarf workers (microergates). The number, too, of these diminutive creatures is limited, so that the whole colony in this incipient stage is a family consisting only of the huge mother and a few dwarf offspring.[a]

Workers much smaller than any found in nature were raised in some of the captive colonies of keleps, doubtless as a result of unfavorable conditions or lack of the normal amount of animal food. Nests with diminutive workers would not furnish proof positive, therefore, that the kelep, any more than the honeybee, ever founds colonies by means of isolated queens. Disease, parasites, or starvation might be expected to bring about in nature, as in captivity, a condition which gives the kelep colony a superficial resemblance to a recently established community of true ants.

The finding of a colony of a few small workers of *Odontomachus clarus* has been reported by Professor Wheeler as evidence that the Ponerida agree with other ants in the method of founding colonies. Other authorities on the classification of Hymenoptera recognize *Odontomachus* as constituting a family distinct from the Ponerida by structural characters. Nevertheless, the similarity of habits between *Odontomachus* and *Pachycondyla* is so great that a difference in social organization seems very improbable. The fact that the *Odontomachus* nest found by Professor Wheeler was in a cavity in a stone may be the explanation of its unprosperous condition.[b]

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[a] Wheeler, W. M., 1902, Science, n. s., vol. 15, p. 768.

[b] Wheeler, W. M., Science, n. s., vol. 15, p. 769: "In a former paper I maintained that the Ponerinæ perhaps constitute an exception to the general method of establishing colonies, but I have recently found in a small cavity in a stone a fertile dealated queen of *Odontomachus clarus* surrounded by five diminutive workers. While it is certainly remarkable that one does not find similar incipient colonies of other Ponerinæ, this observation makes it probable nevertheless that the ants of this family agree with the Componotinæ, Myrmicinæ, and Dolichoderinæ in their methods of founding colonies."

There is supposed to exist among the worker bees a division of labor, but nothing of the kind has been observed among the keleps, except that young individuals, which are easily distinguishable by their lighter color, remain in the nest for many days and perform nurse duty, while the foraging devolves upon the older and darker-colored insects.[a]

The demoralization of some of our imported colonies may have been increased by the lack of a normal succession of young keleps to serve as nurses. The predaceous instincts of the older workers may incline them not only to neglect the larvæ, but to yield more readily to the cannibalistic tendency which some of the colonies have manifested.

KELEP COLONIES NOT HOSTILE.

Kelep nests are frequently placed only a few inches apart, the workers of the different colonies not being actively hostile. Members of two colonies will forage on the same cotton plant or tree trunk with no signs of animosity. Stranger ants introduced into captive colonies for observation have not been attacked. They usually receive little attention; if they enter the burrow they are likely to be brought out and carried to the boundary of the inclosure, but are released without injury. In nature such stragglers, if any, would merely be escorted to the border, as it were.

Under the social economy of the true ants the species consists of fewer and more scattered colonies of larger size. The workers from different nests often have as much animosity for each other as for members of distinct species. This hostility serves a practical purpose, the close proximity of nests being, among the ants, a distinct disadvantage. It is only in large and prosperous colonies that numerous sexual adults can be brought to maturity. Too many colonies close together would mean a general scarcity of food and would keep all the communities poor and unproductive.

The power of ants to distinguish at once between members of their own and of other colonies has long been recognized as one of the most remarkable refinements of instinct, and has been the subject of extensive study and experiment. A recent and extremely careful investigation has been made by Miss Adele M. Fielde, who finds that the

[a] Some species of ants and of termites have a special caste of very small, slender workers which do not leave the nest, but are devoted to nurse duty. These might be looked upon as representing a social specialization by which the microergates are not confined to the first brood. On the other hand the very great specialization of the so-called soldier castes of the termites would seem to indicate that they are the oldest representatives of the worker series, and this view seems to be supported by the fact that the "workers" of *Calotermes*, which have the simplest social organization, are more like the soldiers of other genera than they are like the workers.

olfactory sense, through which the instinct of animosity to strangers is aroused, is so acute that ants will attack even their older sisters if they have been reared without contact with others of like age.[a]

It is much better policy, from the standpoint of the social economy of the ants, for a given area to be occupied by one large colony than by many small ones, and with many of the ants this instinct of hostility is supplemented by that of retaining a part of the young females in the nest. This enables the community to be expanded to the greatest extent possible and avoids the waste of unnecessary competition and conflict.

The more amiable disposition of the keleps has enabled them to reach different and somewhat more democratic solutions of their social problems. They take better care of their young females, and do not find it necessary to make war upon their neighbors of the same species.

Like other carnivorous animals, the keleps become cannibals when driven by hunger, but in normal conditions of Indian agriculture an abundance of keleps in a locality would tend to increase the area planted to cotton, so that their existence would not be subject to the usual laws of competition in the struggle for existence.

Barring accidents which may compel a change of residence, an ant colony remains indefinitely in the same place, but the kelep organization is decidedly more mobile. Colonies can change their locations readily and may do so with promptness when a more desirable spot has been found. One of the ends gained by the kelep in moving would be to leave behind parasites, with which their nests sometimes become infested.[b]

It is a familiar fact in the study of plants that some grow in clusters and others are solitary. If a seed produces only a single

[a] Fielde, A. M., Biological Bulletin, 7: 227. In some of the ants studied by Miss Fielde the aversion to strangers is said to extend even to a "manifest preference" of the females for males from the same colony. It should not be taken for granted, however, that the laying of eggs by queens captured before the mating concourse proves a previous mating inside the nest, nor that all the males which may be found in a nest originated in it.

[b] The habit of frequent moving might also explain the apparent absence among the keleps of the guests or messmates which have attached themselves to many of the true ants. In Guatemala the kelep nests usually harbor a snail or two, a small diplopod of the order Merocheta, a small creamy-white thysanuran, and a worm which infests the bone yard or collection of dismembered skeletons of their prey, which are stored in a special underground chamber.

A few specimens of a hymenopterous parasite identified by Doctor Ashmead as *Isomaralia coronata* Westwood have emerged from some of the captive colonies during the journey to the United States, and even, in two instances, after they had arrived in Washington.

The worst enemy of the keleps, however, is a mite, which has become extremely numerous in some of the cages, especially those inhabited by small and demoralized colonies.

stalk the plants are solitary; if there are numerous buds and branches from roots or underground stems a cluster is formed and the plant is said to have a cespitose habit, depending upon the different method of reproduction. Similarly with the ants and the keleps the former have their colonies remote and hostile, the latter adjacent and friendly, or at least tolerant of each other. And though these differences might at first seem slight and insignificant, they result, in reality, from a fundamentally distinct system of social organization.

It is not only a regular and normal condition for ant colonies to be solitary and remote from each other, but there is a provision of mutual hostility which prevents the establishment of closely adjacent communities. The keleps, on the contrary, are social not only to the extent of forming colonies like the ants, but they are social to the second degree, as it were, in that the breeding habits of the insects provide for the normal existence of closely adjacent communities. Solitary kelep colonies would be as abnormal as closely adjacent ant colonies and as clearly at a disadvantage. Adjacent ant colonies might suffer for food, while a solitary kelep colony might meet extinction through inbreeding if the visits of males from other nests were excluded.

MALES CONTINUOUSLY PRESENT.

Winged males were found in the nests in about the same numbers in November as in June. They appear to be regular inhabitants and are received by all colonies with apparent indifference. They are agile, active insects and could readily pass from one colony to another, thus providing cross-fertilization without annual swarming. Males are not present in all the nests, and the number varied from 1 to 7 or 8, a diversity itself strongly indicative of the absence of the annual emergence, even of the males, at any stated time.[a] The number of males had also no apparent relation to the number of females.

When the nests were opened in Guatemala the males often attempted to escape by running rapidly away, but did not take to wing, although Mr. Lewton informs me that some of those brought to Texas showed their ability to fly. They are, however, so active and fleet of foot that they could pass readily from one colony to another of the closely adjacent nests even without flying. Wingless males are known in some of the species of Ponera, and also in certain parasitic ants.

[a] In Guatemala in the spring the number of males raised by some of the colonies was found to be much greater. Mr. Goll counted about 40 in one nest. Messrs. Kinsler and McLachlan saw numerous males at large in the cotton fields and observed, further, that they are often caught by the workers and carried down into the nests.

QUEENS INACTIVE.

The kelep queens, even when young, are distinctly less active than the workers. Isolated queens have shown no ability or inclination to excavate nests and very little interest in eggs or larvæ which have been intrusted to them.

It does not appear that the keleps have the art of regurgitating food for their larvæ or for each other, but they have, instead, the curious habit of opening their mandibles wide and lapping up drops of nectar, moistened sugar, or honey on their mouth parts. The liquid is thus carried into the nest and dispensed to the other members of the community, old and young. The queen is regularly fed in this way, though in a few instances the queens of captive colonies came to the surface to eat sugar with the workers.

In the true ants the young queen bites off her wings,[a] excavates her own burrow, and cares for her first brood of eggs after having laid them, and appears not to be deficient in intelligence and activity in comparison with the workers. The demeanor of the kelep queens inside the nests differed notably from those of a species of *Formica* kept in the laboratory at Victoria, Tex., for purposes of comparison. The kelep queen is the last to notice any disturbance of conditions, such as the admission of light, but the Formica queens were even more nervous and irritable than their workers and were the first to run for shelter. The same was true of them when their nest was being dug out.

The only instances in which the kelep queens have shown any noteworthy activity have occurred when they were condemned to solitary confinement. As though realizing the uselessness of such an existence these queens often make reckless attempts at escape and run rapidly away, in complete contrast to their usual quiet and sluggish demeanor when associated with workers and eggs or young. In nature, or rather in the Guatemalan cotton fields, this activity on the part of a queen which had for any reason lost her family might be of advantage in enabling her to find a home with some other colony. Strange queens seem always to be welcomed when introduced into a new community with or without a queen of its own.[b] The removal of the queen, on the other hand, does not seem to have any effect upon the actions of the workers as long as there are eggs and larvæ to care for, but workers alone become utterly listless and stand idly about with their

[a] This was observed in Texas by Mr. Frederick L. Lewton in a young queen of *Cremastogaster lævinscula* Mayr.

[b] In one colony studied by Mrs. Cook two strange queens, while not actually bitten, were dragged about in an unfriendly manner and did not long survive.

heads and antennæ in the air, as though waiting for something to happen.

There is no indication that under normal conditions the kelep queen ever leaves the nest voluntarily for mating purposes. There seems to be no record of a queen of this family being captured outside the nest. Mating inside the nest has been reported in another member of the family Poneridæ.[a] Normally wingless females are also known in some of the other genera, which proves that with them, at least, the power of flight has been lost by the females as well as by the workers. In some species of ants and of Poneridæ there is no very sharp line between the workers and the queen, all of the intervening stages being occasionally found. Kelep queens and workers are, however, quite distinct, so far as observed. The queens are two or three times as large as the workers and are of a darker and more reddish color. The workers occasionally lay eggs, but they are of a distinctly smaller size than those of the queen. They remain white instead of turning a deep gray or blackish, like those of the queen, and are apparently recognized as worthless, for they are at once fed to the larvæ, a fact discovered by Mr. F. L. Lewton.[b]

When there are no larvæ the keleps seem not to know what to do with these diminutive eggs, but continue to carry them around in their mandibles. In one small colony I have seen three worker keleps with eggs at the same time, which would seem to indicate either that they are laid in considerable numbers or that they are carried about for considerable periods.

The wings of the female being useless, it might be expected that they would be bitten off as promptly as in the true ants, or even sooner, but this is not the case. It seems scarcely possible that the queen could bite them off herself, even if so inclined, and of such an instinct there is no indication. The wings seem to be worn for an indefinite period. Queens with one or both wings frayed to half their length or less are occasionally found. The wing stumps, also, are of irregular sizes. It seems not unlikely that the workers gnaw them away gradually as a part of the cleaning process.

In *Pachycondyla*, as described by Professor Wheeler, and in *Neoponera*,[c] which occurs in the vicinity of Victoria, Tex., the queens

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[a] Wheeler, W. M., 1901, Biological Bulletin, 2:49.

[b] The laying by workers of eggs of nearly normal size which also turn dark and seem likely to develop normally was reported from Victoria, Tex., by Mr. Argyle McLachlan, after the above was written.

[c] The species of *Neoponera*, which commonly lives in the mesquite bushes about Victoria, has been identified by Doctor Ashmead as *N. villosa* Fab. It is not without interest with reference to the possibility of establishing the kelep in Texas that the distribution of *Neoponera villosa* extends from Texas to Brazil.

and workers are very nearly of the same size, and, except for the possession of wings by the former, look quite alike, while in other genera, like *Leptogenys*, the females, though wingless, are very different from the workers. Such facts might have served as indications of considerable latitude of social specialization in the family as a whole, as abundantly shown when the kelep is added to the series.

The Poneridæ with wingless females seem to ally the group still further with the Dorylidæ and Mutillidæ and increase the contrast with the true ants, where the wings still remain as essential for the females as for the males. It may be needless, perhaps, to add that it is the loss of the wings by the workers and by the queens which marks the course of recent evolution in the Hymenoptera as a whole, as in all other insects. The most primitive insects were winged; all the wingless insects are descended from winged ancestors.[a] The fact that so small a proportion of the members of an ant colony have wings, and these for so short a time, tends to make it appear that the wings are a special provision, while in reality the specialization is all in the direction of winglessness. The ants are in this respect more primitive, since they have preserved a character which is being lost in the Poneridæ and which has entirely disappeared in the Dorylidæ, Mutillidæ, and Thynnidæ.[b]

The winglessness of the queens has been attained, however, by an evolutionary step distinct from that which resulted in wingless workers, and has a very different significance from the standpoint of the social organization of the species.

The winglessness of the workers may be looked upon as a part of the general stunting and sterility of the individual for lack of adequate food. In the early stages of the development of a new colony it is undoubtedly an advantage not to have too many larvæ, which would increase the danger of starvation for the whole lot.[c] The loss or disuse of wings by the sexual females of parasitic wasps, drivers, and Poneridæ, on the other hand, is a sequel of the abandonment by

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[a] Cook, O. F., 1902, The Earwig's Forceps and the Phylogeny of Insects; Proc. Entom. Soc. Wash., 5: 84.

[b] Winglessness of one of the sexes also occurs in several anomalous ants which live as parasites in the nests of other species and establish no independent colonies of their own. In the genus *Tomognathus* the male is winged, but the female is wingless and workerlike. Insects from the same nest have been found not to pair. In the genera *Anergates*, *Formicoxenus*, *Symmyemica*, and *Cardiocondyla* the conditions are reversed, the males being wingless and similar to the workers, while the females have normal wings.

[c] The storing of honey by the bees had for its primary purposes, we may believe, the avoidance of temporary stringency of food during the period of brood rearing, not the laying up of supplies to enable the adult members of the colony to pass the winter. The storing habit enables the bees to occupy temperate regions, but tropical bees also accumulate supplies of honey.

that sex of the habit of flight, which means that the social organization of the species is essentially different from that of the true ants, in which both sexes emerge into the open air for a marriage flight.

MIGRATION OF COLONIES.

In the transfer of a colony of keleps from one nest to another the workers take the initiative. After an excavation has been made eggs and larvæ are carried over. First attention is given to the eggs, the possession of which renders the new colony in a measure independent of the presence of a queen. Even before the new burrow is dug some of the workers load themselves with eggs and stand ready to carry them in.

The ancient popular theory that the communities of the social insects are organized on a monarchical basis finds little support in the way of detailed facts. It has long been known that the nervous system of worker bees and ants is more highly developed than that of the sexual insects, and especially the parts which correspond to the brain of higher animals. Even in the most highly organized society of the termites the workers are the intelligent and efficient part of the community, the queen having no other function than the laying of the eggs from which the huge family is hatched. The termite "mother," as the Africans more correctly call her, becomes enormously distended and completely unable to move. She is kept with her mate in a special chamber with very small entrances through which only the workers can pass, and even these openings are promptly sealed up with earth when the colony is attacked. Among the nomadic "driver ants" the mother of the colony does not lead the procession and never goes abroad in daylight. The natives of Liberia say, however, that in rare instances she is seen at night being hurried along by her numerous family.

Among the honeybees, also, the workers, rather than the queen, take the initiative in matters of the internal management of the colony which lead up to swarming. Unlike the keleps, the bees do not carry eggs or larvæ with them, and are hence completely dependent upon the presence of the queen to insure the perpetuation of the new colony.

QUEENS CARRIED BY WORKERS.

If the kelep queen does not follow at once to the new nest a worker seizes her by the mandibles, raises her in the air, and carries her over bodily. This has been observed repeatedly in connection with the prompt transfers which many of the imported colonies made from their cages into the ground. The queen submits to this treatment as though it were a regular occurrence, and remains quiet and rigid while being carried about. In one instance several workers also re-

mained behind, but were caught and carried by their sisters into the new burrow. This simple expedient avoids many difficulties and complications. The queen need not be possessed of any instinct of leading or accompanying the swarm, as among the bees, and there is no danger of her becoming lost as a result of her comparatively deficient instincts.

The large straight-edged mandibles of the kelep are well adapted for holding or carrying objects of considerable size. Ants with smaller jaws could not catch and sting boll weevils, because they could not hold them in the right position. Numerous ants may be said to *attack* boll weevils, but are able only to seize them by the legs or snouts and drag them about for a time. As soon as released the weevil escapes by its well-learned trick of feigning death. The kelep can pick the weevil up bodily, and in normal positions on the stems of cotton plants can usually sting it while the weevil is still "playing possum," before it begins to struggle. It is accordingly not without interest that the large mandibles and long legs which qualify the kelep as a weevil destroyer have other important functions in the social economy of the species.

It may be mentioned also, as showing the special efficiency of the keleps in moving their domicile, that they seldom carry one egg alone, but will often go to considerable pains to pick up two or three at a time. Sometimes the eggs adhere in considerable numbers, though not as in *Odontomachus*, where they are cylindrical and are made up into compact bundles. Eggs, pupæ, and other objects are frequently pushed between the mandibles by the end of the abdomen, brought up from below as in stinging the boll weevil. Two cocoons are sometimes packed up in this way, so that they can be carried together. It is also by virtue of this same flexibility of the abdomen that the workers are able to assist themselves with their mandibles in the laying of the undersized eggs which they occasionally produce.

DIVISION OF A COLONY.

A colony with two queens spontaneously divided into two by the departure of some of the workers and one of the queens. This incident was observed in Victoria, Tex., by Mr. Frederick L. Lewton, the essential facts being stated as follows:

On July 22 the ants in colony No. 26 exhibited signs of restlessness, and as several had been found dead a new nest was prepared in a larger jar. The two jars were connected by means of a cotton-leaf bridge. The dead ants were immediately carried over to the new jar and also the hard remains of several boll weevils. A considerable amount of earth was also carried from the old nest to the new, but few ants remained in the new jar until its lower half was protected from the light. The protection was removed from the old jar, which was also allowed to become dry, in order to hurry the keleps in removing the colony.

At the beginning of the experiment a number of eggs and larvæ were on the surface of the soil in the old nest. One larva was almost fully grown and about ready to pupate. In twenty-four hours all the eggs and larvæ, except the large one, had been removed to the bottom of the new jar, while the one remaining in the old nest had been taken below and covered with loose earth preparatory to pupating.

In another twenty-four hours there seemed to be almost no communication between the two jars and a close inspection was made. Then it was found that the old colony had contained two queens. One of these had taken possession of the new nest, accompanied by about half the workers and all of the eggs and young larvæ, only the full-grown larva and the workers remaining with the other queen in the old nest. This she would not desert, in spite of the strong light and the dryness. The jar was therefore moistened and protected from the light, and within five days the queen began laying again. The one larva began spinning its cocoon on July 23, and it was finished in about three hours.

COLONIES FOUND WITHOUT QUEENS.

Several kelep colonies containing eggs and larvæ were very carefully explored in Guatemala without finding queens. In view of the simple structure of the nests and the extremely favorable circumstances under which the work was done, it is not considered probable that the queens escaped notice in all these instances. It seems more likely that some of these colonies had been established recently without queens.

REPLACING A QUEEN.

Captive workers alone, as already stated, become listless and confused, but if supplied with eggs their behavior soon becomes normal. Several queen larvæ have been raised in the laboratory at Victoria, Tex., the first two in a colony in the hands of Mr. W. E. Hinds, the others by Mr. Argyle McLachlan. One might argue from Mr. Hinds's experiment great intelligence on the part of the keleps. One of two colonies had lost its queen by an accident, but was supplied with eggs from another on the supposition that a queen would be raised to make good the deficiency. The keleps appeared, however, to have no special desire to have a queen to support as long as they could secure a regular supply of eggs, and continued to raise workers only. The other colony, however, from which the eggs were being removed, took measures at once to raise a new queen, the deficiency of eggs having given, perhaps, the impression that the fecundity of their queen was declining. Two larvæ of unusual size were raised, one of which emerged as a normal winged queen. Mr. Hinds found that the time required for the development of a queen is about three months, the larval and pupal stages being about one and one-half times as long as those of the workers.

Two queens raised by Mr. McLachlan in January and February,

1905, spent 35½ days in their cocoons, a period distinctly less than that of two worker pupæ of the same colony at the same time, which took 40½ and 39 days, respectively. These queens were raised in the same queenless colony previously referred to, after the supply of fresh eggs was cut off. This would seem to show that a scarcity of eggs rather than the bodily absence of the queen may be necessary to set the workers to the development of a new queen. Certain it is that there is no such obvious reaction to the presence of a queen as among the bees. If the accounts of Maeterlinck and other observers are to be credited, there would seem to be among bees either a distinct system of royal etiquette or some direct unexplained influence upon the actions of the workers.

And one may mention here the curious fact that the workers always avoid turning their backs on the queen. No sooner has she approached a group than they will invariably arrange themselves so as to face her with eyes and antennæ, and to walk backwards before her. It is a token of respect, or of solicitude that, unlikely as it may seem, is nevertheless constant and general.[a]

TYPES OF SOCIAL ORGANIZATION AMONG INSECTS.

Insects of several natural groups might be described as social. The larvæ of certain Lepidoptera remain together and even make community webs or cocoons. Some of the bark lice (Psocidæ) also pasture in droves, and in their younger stages spin continuous silk canopies over their feeding places. These communities, while obviously held together by social instincts, are in no proper sense to be termed organized, no division of labor or diversity of form or structure having arisen as a result of the merely gregarious association of individuals. Among the Hymenoptera some of the wasps of the family Eumenidæ represent this primitive social condition. Maeterlinck has traced the social development of the honeybee.[b]

For an adequate outline of the diversity of breeding habits it seems necessary to recognize at least six types of social organization among insects. The contrasts between the different biological conditions found in the several forms of insect society can best be shown by brief formal descriptions.

[a] Maeterlinck, M., 1901, The Life of the Bee, p. 214.

[b] "We find even to-day, among the melliferous Hymenoptera, all the stages of progressive civilization of our own domestic bee. At the bottom of the scale we find her working alone, in wretchedness, often not seeing her offspring (the Prosopis, the Colletes, etc.); sometimes living in the midst of the limited family that she produces annually (as in the case of the humblebee). Then she forms temporary associations (the Panurgi, the Dasypodæ, the Halicti, etc.), and at last we arrive, through successive stages, at the almost perfect but pitiless society of our hives, where the individual is entirely merged in the republic * * *."—Maeterlinck, M., 1901, The Life of the Bee, p. 31.

Interbreeding maintained by a simultaneous annual concourse of all the recently matured insects of both sexes.

Colony founded by a pair of sexual insects which remain permanently mated.

Wings provided with transverse sutures which enable the insects to break them off readily by an upward bending of the abdomen. Both sexes shed their wings in this manner as soon as they have associated in pairs, and then begin digging in the ground.

Workers of both sexes always wingless, numbered by thousands or even by millions, generally of diverse form, or of two or more distinct castes—soldiers, nurses, etc.

Several of these features are not shared by any of the types of organization found among the bees, wasps, ants, or other Hymenoptera. It is only among the termites that the males are regularly found with the females in the nests. Among the Hymenoptera the males are relatively short-lived and take no part in the work of the colony. Sometimes they are not even tolerated in the nests. A single fecundation suffices for the lifetime of the queen bee or ant, while among the termites the process is probably repeated. Copulation has never been observed among the termites; it does not take place during the mating flight, as among the bees. The wings of Hymenoptera are not provided with sutures to render them easily detachable. Males are permanently winged in all the groups; in some the workers are wingless, and in some the females also. Among the ants the queen is artificially wingless, as in the termites. She bites off her own wings after the marriage flight.

Perhaps the most fundamental peculiarity of the termite organization lies in the fact that the workers, soldiers, nurses, or whatever the various castes may be called, are of both sexes, instead of being undeveloped females only, as among the bees and ants. Whether a young bee larva shall develop into a queen or become stunted into a worker or so-called "neuter" depends upon the quantity, and perhaps also the quality, of the food supplied to it. Among the honeybees special brood cells are prepared in advance for the males, the workers, and the queens which the colony proposes to raise.

EXPLANATIONS OF WORKER CASTE.

It has been supposed that the differentiation of the members of termite colonies is governed in the same manner, by nutrition merely, but this is rendered very doubtful by the fact stated above, that the workers of all the different castes represent stunted individuals of both sexes. Another serious weakness in the nutrition theory lies in the fact that the larvæ of the termites are not mere helpless, inactive grubs, as in all the social Hymenoptera, but are quite as capable of locomotion as the adult workers, and are always traveling about to

all parts of the nests, so that the application of a consistent regimen of feeding would become, humanly speaking, impossible.

In some of the relatives of the kelep native in Texas, Professor Wheeler has found that there is no clear distinction between the fertile females and the workers, a condition which he ascribed to the desultory feeding habits of the insects.[a] The deficiency may be connected, however, with the more backward social organization of the Texan species. The keleps, with the same predaceous habits, seem always to be able to produce the two well-defined types; at least no intermediate forms have been observed.

The question has not been put to an experimental test as yet, but the suggestion has arisen in connection with the kelep that the development of a larva into a worker may be brought about in the early stages by withholding food, it having been noticed that the larvæ grow very slowly at first, but after they reach a certain size they often complete their development with great rapidity. A superabundance of food or a special solicitude for the younger larvæ might induce the development of queens without the necessity of supposing that the insects proceed by any deliberate intention.

But even among the keleps the worker caste is hardly to be explained merely by inadequate nutrition, for the reason that it possesses positive as well as negative characters and instincts which the queens do not have, and which they probably never had in the evolutionary history of the species. As previously stated, it is well known that among the bees and ants the nervous system, and especially the part which corresponds to the brain of the higher animals, is much more highly developed in the workers than in the sexually perfect insects, and this is accompanied by the accentuation in the workers of the social instincts by which the colony is maintained.

HIGHLY SPECIALIZED WORKER CASTES.

The more recent evolutionary changes among social insects have been largely in the direction of the workers, the males and females

[a] "Now, while we can, perhaps, understand how these more specialized ants may manage to control the quantity and quality of liquid food regurgitated from their own crops and salivary glands, it is not so easy to understand how ants can exercise such control when they adopt a capricious method of feeding like that of the Ponerinæ. Such a method can hardly produce clear-cut results, i. e., either workers or fertile females. And a comparative study of the better-known species of Ponerinæ shows that in certain species, at least, there is no such sharp distinction between the sterile and fertile female as we find in the more specialized ants. Not only is the female sex in a state of morphological and physiological instability—i. e., di- or even tri-morphic—but the male sex also is sometimes dimorphic, at least in the same genus, if not in the same species."—Wheeler, W. M., 1901, Biological Bulletin, 2: 28.

retaining more nearly the characters and habits of their nonsocial ancestors. The development of the workers has not been confined, however, merely to the more highly specialized nervous system and instincts. In many of the ants and termites there are two, and sometimes three or four, distinct kinds of workers, very different from each other and equipped with an equal diversity of instincts for undertaking special parts of the work of the social organization. One of the African termites has soldiers with immensely large heads and biting mandibles, whose sole function is that of defending the colony. When the wall of the nest is broken they sally out to engage the intruder. They are wholly devoted to this purpose, and lack even the instinct to return again, and soon perish from exposure to the drier, outside atmosphere. A second form of worker, also with large heads, but much smaller jaws, will not leave the nest to fight, but appears to control the erection of new walls, though it does not itself carry earth, a work performed entirely by the third caste, which might be called the worker proper. These build the nests and bring in the dead wood, which, after a period of curing, is made into fungus gardens. The fourth caste is small and slender, and neither fights nor carries earth, but is occupied with the management of the eggs and, presumably, also with the feeding of the young larvæ.

We may be sure that this high degree of specialization of castes has come about during the period of social organization. How the queens are able to give birth to these distinct kinds of offspring is unexplained as yet, either by difference of nutrition or by any of the theories of hereditary transmission applied to the other groups of animals.

Professor Weismann has appreciated the inadequacy of the nutrition theory, even with reference to the honeybee, and has attempted to explain the worker caste by means of his well-known theory of determinants.[a]

[a] "This explanation [nutrition], however, even if correct as regards the degenerated parts of the workers, does not sufficiently account for the other differences between the two kinds of females. For the workers are not inferior to the queen bee in all respects. On the contrary, the worker's sting is straighter, longer, and stronger, and is provided with more teeth than the queen's. The wings, moreover, are longer, the tarsal segment of the hind limb is provided with the well-known brush, and the tibia has a depression known as the 'pocket' for carrying the masses of pollen which the insect collects. These two characteristic parts are wanting in the queen. Important differences must also exist as regards the minute structure of the brain, for the instincts of the queen are very different from those of the workers. After fertilization has taken place the queen lays eggs, but she neither gathers honey from flowers, excretes wax, nor makes the honeycomb. It is therefore incredible that the queen and workers should be formed by the agency of similar determinants.

It is apparent, however, from what has been said regarding the termites of Liberia that Professor Weismann has greatly underestimated the difficulties which his theory of heredity would encounter in that group. As the various castes are not separated on sexual lines, there are five forms of each sex, or possibly six if complemental or substitution royalties are developed. Instead, therefore, of three or four kinds of determinants there would need to be ten or twelve kinds, and since it would be necessary to provide in the same way for the preliminary stages of the various castes more than a score of different determinants would need to be predicated—too many, it would seem, to leave us much confidence in this method of accounting for the existence of the worker caste.

THE ANT SOCIETY.

Interbreeding maintained by a simultaneous annual concourse or mating flight of all the recently matured insects of both sexes.
Colony founded by a solitary fecundated female.
Wings present on young females, but bitten off after the mating flight.
Workers always wingless, often to be numbered by thousands, commonly of diverse form or of two or more distinct castes. Workers of different colonies of the same species actively hostile.

Numerous deviations from this type of organization are to be expected among the various families of the tropical ants, the habits of which are still very imperfectly known. The colonies of many ants, too, are compound, a part of the young females remaining in the parental nest. Miss Fielde describes such a colony of *Stenamma*

The germ plasm must contain double determinants for certain parts of the body of the queen and workers, respectively. But as we have already assumed the existence of double determinants for the formation of male and female bees, or at any rate for the development of those parts which differ in the two sexes, we can only make the further assumption that the 'female' halves of the double determinants may themselves consist of two halves, corresponding to the queen and worker, respectively, and that each of these halves must naturally be looked upon as a complete determinant as regards size and structure. * * * In the case of bees the factor that determines which of the two halves of the 'female' determinant is to become active seems to be the quality of the food supplied to the larva, so that the critical moment only arrives long after the termination of embryogeny and before the chrysalis stage is reached. * * * We might, however, also assume the existence of three independent determinants side by side, so arranged that they become active under other definite influences, and this conception would better agree with the unavoidable assumption that the three determinants which act vicariously are of a similar size. * * * The termites, in addition to the workers or stunted females, possess "soldiers," or males in which the sexual organs are stunted, which possess very strong mandibles and differ in other important structural details from the ordinary males. In this case, therefore, four determinants must be present, each capable of being substituted for another, and only one of which can be active at a time."—Weismann, A., 1893, The Germ Plasm: A Theory of Heredity, 377–379.

fulvum scattered over an area 90 yards in diameter, and states that she has been "unable to find any other colony of Stenammas in its vicinage."[a]

THE BUMBLEBEE SOCIETY.

Interbreeding maintained by free flight of males during the period of emergence of young females.

Colony founded by a solitary fecundated female, the males and workers not surviving the winter.

Workers permanently winged like the sexual adults.

The organization of many of the social wasps is essentially the same as that of the bumblebee. This close similarity of social habits has been accepted by many entomologists as an evidence of relationship between the two groups, but the present tendency is toward the view that the social organization has been attained independently.

THE HONEYBEE SOCIETY.

Interbreeding maintained by the free flight of males during the swarming season, when they are permitted to feed in any of the nests. The young queens emerge from the nests for a nuptial flight, in which fecundation is accomplished.

Colony established by subdivision of the workers of an older swarm, accompained either by the old queen or by a young queen still unfertilized.

Males short lived, usually not tolerated in the nests except during the period of emergence of newly adult females.

Females permanently winged, but the wings used, normally, only in the nuptial flight and in that of swarming.

Workers permanently winged, of one caste, or of slightly different castes, numbered by thousands. The workers of different colonies are not actively hostile except to marauding intruders.

THE KELEP SOCIETY.

Interbreeding probably maintained by the visits of the males to the various adjacent nests; no concourse or nuptial flight of females.

Colony established by a body of workers from an older community. The workers carry eggs, larvæ, and queen with them for the complete equipment of the new nest.

Males permanently winged, but apparently not inclined to fly; tolerated in all nests, and probably present throughout the year.

Females winged at first, but not known to fly or emerge from the nest.

Workers wingless, all of one form or caste, numbered by hundreds; not actively hostile.

In other genera of the same family normally wingless queens are frequently found. In some only wingless queens are known; in others some are winged and others wingless, with no differences in other

[a] Fielde, A. M., 1904, Biological Bulletin, 7: 245.

respects. Fecundation inside the nest has also been observed in a member of the Poneridæ, or kelep family, as already noted.

Though no doubt attained independently, the resemblance of the kelep social organization to that of the bees is fully as striking as the parallel between the ants and the termites. The most serious difference lies in the fact that the queen bee must go out of the nest to be fertilized. Both the keleps and the bees are able to raise new queens as long as eggs are obtainable, but the danger of failure is much greater with the bees because of the vicissitudes of the marriage flight to which the young queen is subjected. In the habit of an open-air mating the bees resemble the butterflies, dragon flies, and other nonsocial insects. Mating inside the nests represents a more advanced and much more practical social system.

It is not difficult to assign a reason for a frequent subdivision of colonies as a feature of the social economy of the kelep. A large colony of predaceous insects would soon exhaust the insect fauna of its immediate neighborhood. It could maintain itself only as the drivers do, by foraging widely and changing quarters frequently. The keleps do not go, apparently, more than a few feet from their burrows. They seem ready to move their nests to more favorable locations, but these migrations are also, in all probability, for short distances only, though the Guatemalan Indians say that the keleps will come in from neighboring areas and occupy a cotton field after the crop has been planted.

THE DRIVER SOCIETY.

Interbreeding maintained by annual emergence and free flight of large numbers of males.

Colonies nomadic, probably increasing by the subdivision of migratory hordes. Larvæ carried about by the workers for long distances.

Females wingless, probably never emerging from the nest unless carried by the workers.

Workers wingless, of two or more castes—soldiers, nurses, etc. Numbered by hundreds of thousands, or millions.

The African "drivers" and the army ants of the American tropics represent another group of social insects popularly associated with the true ants because the workers are wingless. In Liberia the males sometimes fly to lights in the evening in large numbers, which may indicate a definite breeding season for the sexual adults. Most Dorylidæ have been described from workers and males, very few females being known to science. The winglessness of the females may be said to advertise the distinctness of their social economy from that of the true ants, and to ally them with the Mutillidæ. Doctor Ashmead has

also pointed out to me the strong similarity of the males of *Dorylus* to those of the wasps of the East Indian *Vespa doryloides* Saussure.[a]

The scant evidence thus far obtained seems to show that a colony of drivers has only one large, distended queen, like that of the Termites. Emery notes that the last joints of the legs are usually broken off in the specimens known to him.[b] Such mutilation may well arise while the huge creature is being dragged about, as stated by the native Africans.

The interesting feature of the drivers, from the standpoint of the study of the kelep, lies in the fact that the differences between them and the true ants are in several respects the same, though much more accentuated than between the ants and the kelep. Thus, interbreeding is accomplished in both groups by the circulation of the males, the females, apparently, never emerging from the nests. The drivers carry their larvæ, and presumably their queens also, for long distances, their close ranked, rapidly moving columns sometimes requiring several hours to pass a given point. In food habits, too, they are carnivorous, like the keleps. They not only capture insects and other arthropods, but young or helpless vertebrates also. Active creatures even, like rats and mice, are often secured, the pain inflicted by the bites of the drivers causing them to roll about on the ground and thus permit more and more of their diminutive enemies to attack them. Any animal too large to be carried away by a single worker is cut in pieces. The kelep follows the more social plan of moving large insects and centipedes by the combined strength of several workers. The drivers are also like keleps in having a sting which they do not use as a weapon of offense against man, but they bite viciously and will not let go, even though their bodies be pulled loose from their heads.

The association of the keleps with the drivers permits a better appreciation of their habits in two respects. First, the apparently high development of their instinct of place or ability to find their way about, even in new situations. The drivers are fierce warriors,

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[a] Doctor Ashmead informs me that the males of the tribe Amblyponinæ, near relatives of the kelep, are very closely similar to those of the Mutillidæ, even to the structure of the petiole and the venation of the anterior wings.

The flying to lights of the males of the Dorylidæ, or drivers, is also shared by the males of *Myrmosa* and related genera of parasitic wasps formerly placed in the Mutillidæ, but which Doctor Ashmead now separates as a distinct family, Myrmosidæ, intermediate between the Mutillidæ and Vespidæ, but having wingless females like the Mutillidæ and the Dorylidæ. Some of the Bethylidæ also have wingless females, but these are not supposed to have any close affinities with the other families. The Thynnidæ, which have been thought to connect with the Mutillidæ and the ants, likewise have wingless females. Finally, a few of the Mutillidæ are wingless in both sexes.

[b] Emery, E., 1895, Ann. Soc. Entom., France, 64:73.

which actively pursue and capture their prey. They are to be described as predatory, while the keleps are merely predaceous, and like many other predaceous animals their movements are slow and deliberate except when they make a final spring to seize their game. The slow movements of the kelep thus conduce to its efficiency as a hunting insect, and may be looked upon as an evidence of specialization in this direction. *Odontomachus* and the Texan Ponerida, so far as observed, are quicker and more excitable under ordinary circumstances, but they seem not to have developed any such skill in capturing quick-moving insects. The similarity of the keleps to the drivers is greater, however, when the colony moves and the eggs, larvæ, pupæ, cocoons, and queens are carried over to the new burrow. In one instance a few of the workers refused to leave the old nest, but the majority would not permit the colony to be divided in this way and finally captured and carried off the unwilling members in the same way that the queen is removed. One of the Brazilian relatives of the kelep is described by Bates as marching about in the forests in a manner which must give them a considerable resemblance to the drivers.[a]

It is true, of course, that the keleps and the drivers are very distinct, but careful comparison will show that the differences are in degree rather than in kind. They represent possible developments from the same primitive system of organization, while to find a common starting point with the ants it may be necessary to go back to the nonsocial stage. Structurally, too, the keleps are very different from the drivers, but the genus *Cerapachys* and its allies are referred by some authors to the Ponerida and by others to the Dorylidæ. It should be no more surprising that some of the habits of the true ants should be approximated by other groups of independent origin than that the bees and wasps, or that the true ants and the termites, should be so similar.

The idea that any existing group of organisms has given rise to another group is generally, and probably always, erroneous. With respect to any given character, one group may remain primitive while another has advanced, but nothing organic is stationary, and the fact that a plant or animal is primitive in one respect may well be taken as a suggestion that good progress has been made in some other.

Looked upon as ants, the kelep and its relatives are undoubtedly primitive, since they are more like wasps than like other ants, but the

[a] "We were amazed at seeing ants an inch and a quarter in length and stout in proportion marching in single file through the thickets. These belong to the species called *Dinoponera grandis*. Its colonies consist of a small number of individuals, and are established about the roots of slender trees. It is a stinging species, but the sting is not so severe as in many of the smaller kinds."—Bates, H. W., 1875, Naturalist on the River Amazon, p. 9, ed. 4.

theory that their social organization must also represent the primitive condition of the true ants seems not to find confirmation in fact. The relatively small size of the colonies does not make them homologous with incipient ant colonies. They represent a different system of social organization. An increase in the size of the colonies of the keleps would not carry them in the direction of the true ants, but toward that of the drivers, unless they changed their habits and became vegetarians.[a]

These various considerations do not exclude, of course, the possibility that some of the families now included among the true ants may have descended from Ponerid stock, but if so we may expect to find that their breeding habits are not those now ascribed to ants as a natural group, it being highly improbable that insects which had become completely socialized, like the keleps, should abandon this condition and return to the relatively crude and wasteful system followed by the ants and termites.

AMBIGUOUS USE OF THE TERM "SWARM."

Care has been taken in the preceding diagnoses of the types of social organization to refer to the simultaneous annual emergence of winged individuals of both sexes as a *concourse*, reserving the term *swarm* for its original use with the bees, and for an entirely analogous application to the kelep.

With the bee and the kelep the swarm is made up of workers (undeveloped females), and it is obviously incorrect, or at least very inexact, to apply the same word to a collection of winged adults of both sexes, as among the ants and termites.

Swarming, as with the bee and the kelep, is a process which does not take place at all in the other types of social organization. It results in the foundation of a new colony by the spontaneous subdivision of the workers of an older community, an occurrence not known among the termites and true ants.

The simultaneous emergence of the newly matured males and females from all the nests of the species has for its object cross-fertilization. It is a time specialization not attained by the honey-bees nor by the keleps, among which facilities for interbreeding are maintained throughout the season. The swarming of the bee and the kelep has, in fact, no connection with the cross-fertilization of the

[a] If the laying of few eggs and living in small colonies is to be looked upon as a primitive character, the genus *Ponera* is the most backward of the American series of Poneridæ and the kelep the most advanced. Such a criterion can not be applied at random, however, since specialization may tend toward restricted fecundity as well as in the opposite direction. Whether an insect would prosper best in colonies of 10, 100, or 1,000 would depend on its habits and environment.

sexual insects, which may take place either before or after the division of the colony.

DETERMINATE AND INDETERMINATE COLONIES.

An insect colony in which all the eggs are furnished by a single laying queen is a strictly determinate organization; that is, it reaches a natural limit after the mother insect dies or ceases to produce. The queens of ants and termites are sometimes enormously fertile and live for many years, so that determinate colonies may sometimes attain large size.

Colonies may be called indeterminate when the social economy of the insect is such that a lost queen can be replaced. This is the case with the honeybee, which may be said to have a simple indeterminate colony because each hive has but a single laying queen. Colonies with more than one egg-producing queen may be called compound indeterminate. This condition has been reached in two different ways. Some of the termites, for example, are able to replace a lost queen by what are called complemental queens, individuals which are brought to a precocious sexual maturity, but without becoming fully winged. Other termites, such as the South European *Termes lucifugus* studied by Grassi, seem to have gone over entirely to the complemental queen basis, thus reaching a completely indeterminate organization. With the ants the same result has been reached in a slightly different manner. Some of the young queens are fertilized and drop their wings before emerging from the parental nest, and, being tolerated by their mother and sisters, they remain to contribute to the numerical prosperity of the family.

A condition very similar, superficially, to that of the clustered colonies of the keleps is to be found in certain ants and termites which have the habit of making what might be called multiple nests. Instead of constructing a single compact dwelling, a colony may spread out into several distinct burrows or nests, connected by galleries, sometimes very long. An instance of this among the ants has been cited already on page 27. In one species of the termites, a single colony often builds numerous nests of considerable size on widely separated branches of the same or neighboring trees in the forests of Liberia. The queen, however, does not live in these aerial summer-houses, the eggs being carried up by the nurses through the galleries which connect with subterranean burrows.

It is conceivable, however, that the compound indeterminate colony might have originated in a more direct manner among insects which have never passed through the determinate stage of social organization. Social organization probably began, as already suggested, with

a condition of gregarious association of equal individuals. With the ancestors of the termites and ants this became gradually more centralized and specialized until a completely monarchical system was attained, which is still followed, at least in the early stages of new colonies.

With the kelep, however, there is no indication of a social history of this kind. The primitive society of equal individuals became specialized into two castes, the workers and the layers, so to speak, but there is nothing in the habits of the insect to indicate that there ever was a definite restriction to one fertile female for a colony.

COMPLETE SOCIALIZATION OF THE KELEP.

With the ants the colonies are founded by solitary queens and held apart by definite instincts of hostility, but the keleps separate into small colonies merely for economic reasons, as it were, to find new feeding grounds. The colony itself is a different social phenomenon in the two groups. Viewed from what might be called the geographical standpoint a colony in a new place is a new colony, however planted, but viewed from the standpoint of the insects and their social organization there is a fundamental distinction. A new colony of ants is really a new social group, a distinct family, but there are no such things, apparently, as new groups of keleps; there are only subdivisions of older groups. The female or queen ant leaves the old group and exists for a considerable period as a solitary independent insect, but there is no provision in nature for a solitary kelep. The kelep is completely socialized, if such an expression may be permitted, while the ant is not. Indeed, it may be claimed that the social organization of the kelep is more perfect than that of any insect whose life history has become known thus far. It is less specialized than that of the honeybee, perhaps, but is more complete, for even with the bees the young queens are obliged to leave the hive for the nuptial flight.

Complete socialization involves, apparently, the transfer of the chief responsibility, the social center of gravity, as it were, from the queens to the workers. The colonies of the bumblebees, wasps, and termites are governed, or at least founded, by the queen or mother; they represent the social principle of *matriarchy*, while colonies of the bees, keleps, and probably the drivers also, are founded and managed by the workers. In the matriarchy of the bumblebees, according to Maeterlinck, the queen-mother has to protect her eggs to prevent their being destroyed by her older daughters, but in the *ergatarchy* of the honeybees the queen is restrained by the workers from destroying her own fertile progeny and possible successors, against whom she entertains sentiments of deadly jealousy. It is not to be supposed, of course, that the queens of the ants and termites issue orders

or actively control the colony when once established, but even then there is an important difference in social economy, as pointed out in another place. The success or vital efficiency of a colony of ants or termites depends upon the number of sexual insects or royalties it can produce, but among the bees and kelebs prosperity is measured, primarily, by the number of workers, which have become quite as necessary as the queens in the establishment of new communities.

The founding of a new colony among the ants and termites is an incident or direct sequel of the process of sexual reproduction. The sexual insects emerge simultaneously from the different nests of the species for their mating flight, but do not return, the few survivors remaining to found new colonies where chance has carried them. The workers do not figure in the *swarming* process at all; they function merely as nurses to assist the queen in raising their sexually mature brothers and sisters.

The honeybees have modified this programme to the extent that the young queen does not attempt, by herself, to establish a new community, but returns to her family after the mating flight.[a] The kelebs, however, have achieved a much more complete separation of their political system from strictly reproductive complications. The foundation of a new colony not only does not depend upon the initiative of the queen, but may be undertaken quite without her presence.

Cross-fertilization or interbreeding among the members of the species is undoubtedly a necessity for the kelebs, as for all other highly developed organisms, but it may not be nearly as acute a requirement as among the termites, honeybees, and true ants, whose social systems make far greater demands for fecundity on the part of the queens. If, on the analogy of the bees, the eggs of an unfertilized queen will produce only males, the deficiency of the latter sex would be automatically made good for that particular neighborhood at least.

The predaceous habits, the winglessness of the workers, and the lack of any instinct to forage a long distance from the nest forbid the formation by the kelep of large communities like those of the bees, but this need not keep us from appreciating the advantages of the kelep organization, which by its greater mobility enables the insects to keep nearer the source of supplies without being obliged to waste so much energy as do the ants in carrying in their food, and without, like the drivers, giving up a settled existence altogether.

It becomes, also, even more obvious than before that the kelebs may prove to have only the most superficial similarity to the ants, and that the social systems of the two groups may be of entirely independent development. The striking parallel between the bees and the

[a] The impregnation of the young queen bee is said to take place occasionally during the swarming flight.

keleps does not prove, of course, a common descent from a social ancestor any more than does the agreement of the ants with the termites, or that of the bumblebees with the wasps. There are still many solitary bees among which a colony organization might grow up; also solitary wasps, some of which associate gregariously; and, finally, there are solitary wasps with wingless females which have undoubted relationships with the drivers and the keleps. The ant organization can hardly be looked upon as a further specialization from this series. The breeding habits prove conclusively that the history of the ants involves an independent specialization, probably from some nonsocial ancestry, but certainly not from one which had attained any such organization as the keleps or the drivers, or any such tendency to winglessness in the female sex as shown in the Mutillidæ and other related groups of parasitic wasps.

The feeding of the larvæ with captured insects by ants of the family Myrmicidæ has been cited by Professor Wheeler as evidence in support of a suggestion of Professor Emery that this family of ants was derived from the Poneridæ.[a] But even if this correspondence be accepted as a true indication of relationship it can scarcely mean more than that the ancestors of the ants were predaceous insects like the keleps and the drivers. The latter groups have kept the predaceous food habits, but among the ants there is still to be found the even more primitive instincts of an annual emergence of both sexes from the nest and the founding of new colonies by solitary females.

On the other hand, it must be admitted that the habits of the genus *Stigmatomma*, as described by Professor Wheeler, offer many more points of resemblance to those of the kelep than do those of Ponera and the Texan genera *Pachycondyla* and *Leptogenys* studied by Professor Wheeler. The larva of *Stigmatomma*, which "does not conform to the Ponerine type," is much more similar to that of the kelep, as are also the eggs.

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[a] "There still exists an ecological (or biological, in the German sense) connection between the Ponerinæ and the Myrmicinæ, as I have lately ascertained. Since describing the peculiar method employed by the Texas Ponerinæ in feeding their larvæ, I have found that one of our New England Myrmicine ants, *Stenamma* (*Aphænogaster*) *fulvum* Rog., subsp. *aquia* Buckl., var. *piceum* Emery—an ant very common under stones and in rotten logs along the edges of woods—has essentially the same method of feeding its young. My attention was first called to the fact in an artificial nest belonging to Miss Adele M. Fielde, at Woods Holl, Mass. One afternoon Miss Fielde left a lot of queen pupæ and larvæ of *Cremastogaster lincolata* within reach of the Stenamma colony. By the following morning the Stenammas had carried these into their nest, cut off their heads and abdomens, and had distributed the pieces freely among the larvæ, which could be seen singly and in groups of from two to five eagerly feeding on the juices in the same manner as Ponerine larvæ."—Wheeler, W. M., 1901, Biological Bulletin, 2 : 65.

It becomes apparent that the species of so-called Ponerida or Ponerinæ of which the habits are known belong to five different natural groups which are likely to be recognized at some future time as distinct families; at least the differences of habit and social organization are as great or greater than those of many families or orders among the higher plants and animals. It is becoming more and more appreciated that such characteristics afford as good or better indications of evolutionary history than do mere differences of structure and proportions. Indeed, the evolutionary significance of a structural character can not be determined until the biology of the plant or animal is known—that is, its mode of existence and place in the economy of nature.

There may be said to be two methods of classification, corresponding to the two states of knowledge regarding a group of animals or plants. Under what may be called the analytical system, classification is based primarily on a logical analysis of formal characters, the various groups, such as orders, families, genera, and species being reached from the top downward by repeated subdivision. The concrete or synthetic method reverses this procedure. Coherent groups of normally interbreeding individuals are recognized as constituting species; closely allied species are grouped into genera, and genera into families.

Owing to their vast numbers and diversity, the classification of insects is still largely in the analytical stage, so that recognition of the kelep as representing a distinct family would not be consistent with the current classification. Nevertheless, it may be fully expected that in due time the insect groups will be treated in better accord with the methods by which the mammals, birds, and other higher animals are classified.

The five groups referred to above may be typified by the genera *Stigmatomma*, *Odontomachus*, *Ponera*, *Pachycondyla*, and *Ectatomma*. The first and second groups have already been recognized as families or subfamilies because of structural peculiarities of the adult insects, the Amblyponinæ (including *Stigmatomma*) having no deep constriction behind the node or first abdominal segment. The Odontomachidæ are characterized by their remarkable mandibles, which are inserted close together near the middle of the head instead of at the anterior corners, as in all the related groups. The true Ponerida, as represented by the typical genus Ponera, show the most backward stage of social organization and have very small colonies. The larvæ are provided, according to Professor Wheeler, with four pairs of peculiar adhesive dorsal tubercles, supposed to have the function of holding them in position against the sides of the nest chamber. In *Pachycondyla* and *Leptogenys* the larvæ are, like

those of *Odontomachus*, provided on each segment with a transverse row of conical tubercles, each surrounded with a circle of hairs, and except for these the surface is naked. In *Ectatomma*, on the contrary, the larvæ, like those of *Stigmatomma*, have a uniform coat of fine hairs. In Odontomachidæ and Pachycondylidæ the eggs are cylindrical-oblong and adhere in bundles; in the Amblyponidæ and Ectatommidæ they are elliptical and adhere only in loose and irregular masses. The Amblyponidæ, Ponerida, and Ectatommidæ excavate subterranean chambers, while the Odontomachidæ and Pachycondylidæ make, as far as known, only irregular anastomosing galleries.

DOCTOR ASHMEAD'S NEW CLASSIFICATION OF THE PONERIDÆ.

On consulting Dr. William H. Ashmead, of the United States National Museum, the eminent specialist in the study of the Hymenoptera, it was learned that in a still unpublished revision of the classification of the ants and allied insects he has recognized all these five groups as representing distinct families, subfamilies, or tribes on the basis of structural characters of the adult insects.

As this new arrangement undoubtedly represents an important advance toward a natural and adequate classification of the kelep and its relatives, Doctor Ashmead was requested to permit the publication in this place of a brief extract from his manuscript, and he has kindly consented. The following analytical keys show the characters by which the kelep and its immediate relatives may be distinguished from other subfamilies and tribes.

SYNOPSIS OF SUBFAMILIES OF PONERIDÆ.

1. Hind tibiæ with *two* apical spurs 2
   Hind tibiæ usually with *one* apical spur, rarely without an apical spur; claws simple, or pectinate ..... Subfamily I. PONERINÆ
2. Abdomen with only *one* joint to the petiole, the constriction between the second and third segments very shallow, the second segment therefore not nodiform; claws simple, cleft, or with a tooth beneath.
   Subfamily II. PACHYCONDYLINÆ
   Abdomen with apparently *two* joints to the petiole, the constriction between the second and third segments very deep and strong, the second segment therefore nodiform, nearly as in the Myrmicidæ; claws cleft or with a tooth beneath ..... Subfamily III. MYRMICIINÆ.[a]

[a] This subfamily represents a peculiar genus of ants found in Australia resembling the genuine Myrmicidæ, and formerly classified with them, on account of the two-jointed abdominal petiole; but they are undoubtedly Ponerids, and Forel and Emery are right in removing them to this family. All of the species fall in a single genus, *Myrmicia* Fabricius.

SYNOPSIS OF TRIBES OF PONERINÆ.

1. Claws simple 2
   Claws pectinate 5
2. Hind tibiæ with *one* apical spur 3
   Hind tibiæ *without* an apical spur ..... Tribe I. ONYCHOMYRMICINI
3. Promesonotal suture usually present; apex of the abdomen from the third segments normal, not curved downward, but porrect 4
   Promesonotal suture wanting or obsolete; apex of the abdomen from the third segment abnormal, curved downward in such a way that it is directed forward beneath; antenna ending in a distinct club.
   Tribe II. CERAPACHYINI
4. Head oblong, the eyes *not* especially small, placed at or a little *beyond* the lateral middle; thorax not constricted at the middle.
   Tribe III. PROCERATIINI
   Head oblong or oval, the eyes usually small, oval, placed *before* the lateral middle sometimes near the base of the mandibles (in a single case very minute and placed at the middle) ..... Tribe IV. PONERINI
5. Head oblong oval, the eyes not small, placed near the lateral middle, thorax long, slightly constricted before the middle, the metanotum longer than the mesonotum, convex above; mandibles subtriangular, curved downward with an oblique but broad masticatory edge.
   Tribe V. LEPTOGENYINI.[a]

SYNOPSIS OF TRIBES OF PACHYCONDYLINÆ.

1. Claws cleft or *with* a tooth beneath 6
   Claws simple *without* a tooth beneath 2
2. Head usually oblong, the eyes, when present, never large; thorax usually with one or more sutures; if without sutures, the head, thorax, and first two segments of the abdomen are longitudinally grooved 3
   Head quadrate or subquadrate, very little longer than broad, the eyes very large, placed at the sides close to the base of the mandibles; the thorax oblong, subquadrangular, without sutures above or with only the metanotal suture present; scale of abdominal petiole subquadrate.
   Tribe I. LIOPONERINI
3. Head variable, although usually oblong, but *not* longitudinally grooved, the eyes rather small oval or oblong oval, placed anteriorly *before* the lateral middle, sometimes near the base of the mandibles; mandibles usually more or less triangular, the masticatory margin dentate; if slender, the

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[a] Tribe I. Onychomyrmicini: Represented by a single genus, *Onychomyrmex* Emery, found in India.

Tribe II. Cerapachyini: Well represented in America. The genera are: *Sphinctomyrmex* Mayr, *Phyracaces* Emery, *Cerapachys* Smith, *Parasyscia* Emery, *Syscia* Roger, and *Cystias* Emery.

Tribe III. Proceratiini: Genera: *Discothyrea* Roger, *Sysphincta* Roger, *Proceratium* Roger, and *Prionopelta* Mayr.

Tribe IV. Ponerini: A group of world-wide distribution. Genera: *Centromyrmex* Mayr, *Trapeziopelta* Mayr, *Myopias* Roger, *Cryptopone* Emery, *Rhopalopone* Emery, and *Ponera* Latreille.

Tribe V. Leptogenyini: A tribe readily recognized by its members always having the claws pectinate. Genera: *Prionogenys* Emery, *Leptogenys* Roger, *Lobopelta* Mayr, and *Simopone* Forel.

mandibles have a large tooth within near the middle; thorax narrowed posteriorly, with all the sutures, or at least the promesonotal suture, present; first abdominal segment well separated from the second by a strong constriction and a movable joint 5

Head oblong, sometimes longitudinally grooved, the eyes, when present, oval or oblong, placed on the sides near or a little *beyond* the middle, never far anteriorly; mandibles most frequently rather long and narrow, with teeth along the inner margin; if triangular, the masticatory margin is edentate; thorax rarely much narrowed posteriorly, the sutures sometimes present, sometimes wholly absent; first abdominal segment *not* well separated from the second, usually broadly sessile with it, and without a movable joint between 4

4. Head, thorax, and first two segments of the abdomen *not* longitudinally grooved, the sutures of the thorax distinct; mandibles rather long and narrow, acute at apex, and armed with teeth along the inner margin; eyes sometimes absent; if present, oval, placed at or near the middle of the sides of the head ..... Tribe II. Amblyoponini

Head, thorax, and first two segments of abdomen longitudinally grooved, the sutures of the thorax entirely absent; mandibles obliquely truncate at apex, *without* teeth; eyes oblong, placed on the sides of the head a little behind the middle; scape of antenna short, not half the length of the head ..... Tribe III. Cylindromyrmicini

5. Thorax always narrowed posteriorly, with the pro-, meso-, and metanotal sutures usually present, or at least with the pro- and mesonotal sutures present, scape of antenna long, usually reaching to the apex of the head or nearly to it; scale of abdominal petiole usually higher than long; eyes placed on the sides of the head, usually between the middle and the base of the mandibles, rather close to the mandibles.

Tribe IV. Pachycondylini

6. Thorax rather long, narrowed posteriorly much as in the *Pachycondylini* and with usually one or more of the notal sutures present, the sides never parallel, usually more or less constricted medially, but never strongly constricted, mandibles never very long, and *not* curved upward, usually with a slight curve downward; head oval-quadrate or oblong, the eyes not large, placed on the sides, usually a little *before* the middle, rarely behind the middle ..... Tribe V. Ectatommini

Thorax very long and cylindrical, the sides parallel, or nearly, the pronotal suture alone distinct, the meso- and metanotum closely united *without* a trace of a dividing suture; mandibles abnormal, very long, slender, and curved upward, the inner margin from the basal angle armed with two rows of minute teeth; head oblong, the eyes large and placed close to the base of the mandibles ..... Tribe VI. Drepanognathini.[a]

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[a] Tribe I. Lioponerini: Represented by a single genus, *Lioponera* Mayr.

Tribe II. Amblyoponini. Genera: *Myopone* Roger, *Mystrium* Roger, *Emeryella* Forel, *Stigmatomma* Roger, *Mesoxena* Smith, and *Amblyopone* Erichson.

Tribe III. Cylindromyrmicini: A tribe found only in the Americas and represented at present by two genera, *Cylindromyrmex* Mayr, and *Thaumatomyrmex* Mayr.

Tribe IV. Pachycondylini: This tribe is well represented in America, Asia, and Africa, probably a dozen genera being already characterized. Those known to me are: *Odontoponera* Mayr, *Diacamma* Mayr, *Plectroctena* Smith, *Bothrioponera* Mayr, *Belonopelta* Mayr, *Pseudoponera* Emery, *Brachyponera* Emery.

It is worthy of notice that Doctor Ashmead finds structural characters which require the separation of Leptogenys from Pachycondyla, Neoponera, and other immediately related genera. The fact that Professor Wheeler found the habits, eggs, and larval characters of *Leptogenys* and *Odontomachus* so closely similar to those of *Pachycondyla* only increases the significance which may well be attached to the differences in these respects between *Ectatomma* and the *Pachycondyla* series.

HABITS OF PONERIDÆ.

The habits of the insects of the family Poneridæ, with which the kelep would be associated in current zoological classification, were almost completely unknown until the recent investigations by Professor Wheeler. It is evident, however, from his interesting papers, that the Texas Poneridæ studied by him must belong to series quite remote from the kelep. The eggs of the kelep, for example, are elliptical in shape and not cylindrical, as in *Odontomachus* and in the Poneridæ investigated by Professor Wheeler.

The breeding habits and the characteristics of the eggs and larvæ of the Ponerinæ exhibit striking deviations from those of other ants. I have not seen the eggs of *Odontomachus*, but throughout the month of May I have often happened on the eggs of *Pachycondyla* and *Leptogenys*. These are white and of a slender, oblong shape, somewhat smaller in the latter than in the former genus. They differ in shape from the eggs in species of *Eciton*, *Camponotus*, *Formica*, *Pogonomyrmex*, *Solenopsis*, and *Tapinoma*; for the ants of these genera, representing several subfamilies, agree in having elliptical and much less slender eggs than the Ponerinæ. The Ponerinæ also keep their eggs in more regular packets, the long axes of the different eggs being placed parallel with one another.[a]

It would probably be an advantage for the kelep to have eggs like those of the *Odontomachus*, which readily adhere in bundles and can be the more easily carried, but the difficulty is overcome by the greater intelligence of the kelep, which adroitly uses the posterior end of its

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Mesoponera Emery, *Pachycondyla* Smith, *Euponera* Ford, *Neoponera* Emery, and *Ectomomyrmex* Mayr. The genera *Psilidomyrmex* André, and *Heteroponera* Mayr, which I have not seen, appear to belong to this tribe.

Tribe V. Ectatommini: This tribe is abundantly represented in Central and South America and in Africa. Only a few forms occur in North America, and these in the Southern States. The genera placed here at present are: *Platythyrea* Mayr, *Alfaria* Emery, *Stictoponera* Mayr, *Ectatomma* Smith, *Gnamptogenys* Rogers, *Acanthoponera* Mayr, *Paraponera* Smith, *Holcoponera* Mayr, *Rhytidoponera* Mayr, *Streblognathus* Mayr, *Dinoponera* Roger, *Paltothyreus* Mayr, and *Magaponera* Mayr.

Tribe VI. Drepanognathini: This is a peculiar little group known only from Asia and Africa, and but few species have been described, all falling into a single genus, *Drepanognathus* Smith.

[a] Wheeler, W. M., 1901, Biological Bulletin, 2:14.

abdomen to load several eggs between its mandibles. Sometimes also the eggs of the kelep adhere somewhat in irregular clusters, so that several can be lifted and carried at once.

The superior social organization of the kelep is also rendered evident by important differences in feeding habits.

The Ponerinæ do not seem to feed one another, like the specialized ants. In captivity *P. harpax* would eat the yolk of an egg or even sugar, but it would not eat termites. *L. clongata* devoured termites and small caterpillars with avidity, but would not eat flies. *O. hæmatodes* is more omnivorous; besides caterpillars, house flies, beetles, and small Hemiptera, it will eat sugar, bread, cake, etc.[a]

The kelep does not appear to have the art of regurgitating food as do the true ants, but it is the regular custom of the workers to gather up on their mouth parts large drops of nectar, sirup, or honey, which are carried into the nest and freely dispensed to the remaining members of the community, as well as to the queen and larvæ. The use of nectar and other sweet substances by other Ponerida seems not to have been reported. The adult keleps seem to be able to live for an indefinite period on sugar alone, though animal food is probably necessary for the normal growth of the larvæ. Termites and insects of all the principal groups are eaten readily.

The extent to which the keleps normally depend upon nectar has not been adequately learned as yet. It may be that they use it largely, if not exclusively, for feeding the very young larvæ, since these do not seem to be regularly fed with animal food, captured insects always being given, as far as observed, to the large larvæ. Colonies fed exclusively on sugar or honey have raised larvæ to nearly the full size, but these seldom, if ever, pupate normally, and in some of the captive colonies very few pupæ have survived to emerge as adults. Sometimes the cocoons are opened and the pupæ taken out and eaten; in other instances they are thrown on the bone yard or refuse heap which each colony maintains. Messrs. Lewton and McLachlan are inclined to believe, after a series of very careful observations, that this mortality is sometimes due to the attacks of the mites, especially when colonies become weak and discouraged. Prosperous colonies, on the other hand, may receive no aparent injury from the presence of large numbers of mites.

The most prosperous of the colonies which have been kept under laboratory observation is one at Victoria, Tex., which was used as the basis of a feeding experiment to see how many boll weevils it would destroy. From 10 to 30 weevils a day was the regular ration,

[a] Wheeler, W. M., 1901, Biological Bulletin, 2:11. Mr. McLachlan reports that a colony of *Pachycondyla harpax*, captured near Victoria, devoured termites greedily.

but in one instance over 50 weevils were killed inside of twenty-four hours, and in the course of the experiment the colony disposed of between 1,200 and 1,500 weevils.

The nests of the keleps, though small and simple in comparison with those of the termites and true ants, consist of chambers several square inches in extent, with level floors and arched roofs, and denote a state of architectural advancement much greater than that reported by Professor Wheeler in the Texan genera studied by him.

The nests of the three Ponerinæ agree in being of a very primitive structure. They consist of a few simple and irregular burrows, or galleries, some of which run along the surface of the soil immediately beneath the stone or log, while others extend down into the soil obliquely or vertically to a depth of 8 or 10 inches. These burrows may anastomose, but they are not widened at certain points to form chambers, as in the nests of the more specialized ants (*Atta*, *Pogonomyrmex*, *Camponotus*, etc.). Even in artificial nests of the Lubbock pattern the Ponerinæ dig only anastomosing galleries scarcely more than a centimeter in diameter.[a]

TEMPORARY BROOD CELLS OF THE KELEP.

The alliance of the kelep system of organization with that of the wasps and bees receives support also from the instinct of inclosing the pupating larvæ in what may be termed temporary brood cells. It has been reported of some ants and of some genera of Poneridæ that they bury their larvæ before pupation. The kelep, instead, constructs over them a cell of earth, if no other materials are at hand, but prefers pieces of old cocoons if these are obtainable.[b]

The bees and wasps avoid the labor of inclosing each wriggling larva separately by a system of permanent brood cells in which the larvæ are reared, and which have merely to be sealed over at pupation. Many of the true ants (and also the drivers) have abandoned the use of cocoons and of the brood cells in which they can be spun. With them the digging of extensive subterranean nests and the careful handling of the larvæ have made external protection unnecessary. Nevertheless, the failure to make brood cells deprived the

[a] Wheeler, W. M., 1901, Biological Bulletin, 2 : 3.

[b] The honeybee also makes use of silk from old cocoons in the construction of brood cells.

"Into the material used in constructing brood combs bees often incorporate bits of wax and fiber-like gnawings of cocoons from old combs in which brood has been reared, and if given cappings or trimmings of combs they will work them all over and utilize most of the material. Also when the bees have abundant supplies of pollen much of this is incorporated into the material of brood combs, thus saving the costlier substance—wax."—Benton, Frank, 1899, The Honey Bee, Bul. 1, n. s., Division of Entomology, U. S. Department of Agriculture, p. 27.

ants of the possible evolution of the art of storing liquid food like the bees.[a]

The position of the brood cells has doubtless had an important influence on the evolution possible to the different groups of social insects. The brood cells of the kelep are built over the larva as it lies on the floor of the chamber. Those of the honeybee are also horizontal, though piled, as it were, in double tiers. The cup-like cells of the bumblebees stand erect.

The instinct of making honeycomb was evidently attained as a further step in the practice of constructing permanent brood cells in advance of the egg laying. Among insects, as with man himself, progress toward civilization has largely come through the accentuation of parental instincts.

The underground activities of the keleps are much less extensive than those of the ants. The galleries of their nests are simple and nearly straight, and the chambers relatively small. There are none of the winding passages to which the termites and true ants are so partial, and which make the complete investigation of their domestic habits so difficult.

WEEVIL-STINGING WASPS.

The incredulity with which the report of the weevil-stinging ant was received by entomologists shows how completely incongruous such a habit appeared when ascribed to an ant. The biological anomaly largely disappears, however, with the recognition of the fact that the natural relationships of the kelep lie with the parasitic wasps rather than with the ants. The stinging of other insects by predaceous wasps is an old and familiar fact. It is true that most wasps prey upon spiders, caterpillars, flies, cicadas, crickets, cockroaches, or even upon bees or ants; but there is one family, the Philanthidæ, which regularly attacks beetles. One of these wasps even makes a specialty of beetles of the weevil family.

The species of the genus *Cerceris* are numerous in Europe, and several of them are known to make burrows in the ground and store them with beetles for the benefit of the future larvæ. The beetles chosen differ in family according to the species of *Cerceris;* but it appears from the observations of Fabre and Dufour that one kind of *Cerceris* never in its selection goes out of the limits of a particular family of beetles, but, curiously enough, will take insects most dissimilar in form and color provided they belong to the proper family. This choice, so wide in one direction and so limited in another, seems to point to the existence of some sense, of the nature of which we are unaware, that determines the selection made by the insect. In the case of our British species

[a] "Though also making special 'honey tubs,' some of the bumblebees commonly use old brood cells for the storage of honey."—Sharp, David, 1901, Cambridge Nat. Hist., Insects, 2:56.

of *Cerceris*, Smith observed *C. arenaria* carrying to its nest Curculionidæ of very diverse forms, while *C. labiata* used a beetle—*Haltica labida*—of the family Chrysomelidæ.

The beetles, after being caught, are stung in the chief articulation of the body, that, namely, between the pro- and meso-thorax. *Cerceris buprestícida* confines itself exclusively to beetles of the family Buprestidæ. It was by observations on this insect that Dufour first discovered the fact that the insects stored up do not decay; he thought, however, that this was due to the liquid injected by the wasp exercising some antiseptic power; but the observations of Fabre have shown that the preservation in a fresh state is due to life not being extinguished; the stillness, almost as if of death, being due to the destruction of the functional activity of the nerve centers that govern the movements of the limbs.[a]

Between the habits of such wasps and those of the keleps the differences are certainly less than between the keleps and the true ants, and another wasp of the same family shows how the transition from the parasitic to the predaceous stage could be passed very gradually. Instead of concluding its maternal duties by stocking its nest or burrow with paralyzed insects in advance, *Philanthus apivorus*, which preys upon the domestic honeybee, provides only one individual at first and returns later to bring others, as required by the growing larvæ. Moreover, it has the habit of crushing its prey in its mandibles, thus giving the larva easier access.[b] The kelep system represents a further improvement, the captured weevils being pulled to pieces and distributed to numerous larvæ. In one group of Hymenoptera, the sawflies, the larvæ have well-developed legs and are able to crawl about like caterpillars, which they very much resemble. In all the other families the larvæ are legless, helpless grubs. Most of them are, in the larval stage, parasites, either of plants or of animals. Those which are not parasitic require, obviously, to be fed and cared for by their mothers, a condition most conducive, obviously, to the development of social habits.

The distinction between predaceous and parasitic habits is not easy to draw. Mrs. Cook saw three young kelep larvæ at one time attached to a termite which the workers were still carrying about to feed to the larger larvæ, which seem to secure nearly all of the direct attention of the workers. If the prey remained alive such attached larvæ would be looked upon as parasites.

The manner in which the keleps feed their prey to their larvæ is thus to be looked upon as a derived rather than as a primitive trait, compared with the habits of the other carnivorous Hymenoptera.

[a] Sharp, David, 1901, Cambridge Nat. Hist., Insects, 2:125.

[b] There are two other significant approximations of habits between the kelep and these wasps of the family Philanthidæ. They seize their prey in their mandibles and sting it by bending the body around underneath, to reach the vulnerable point. *Philanthus* also makes long burrows in the ground, with chambers at the end in which the eggs are laid and the young reared.

The parasitic groups avoid all further labor in behalf of their young by simply laying their eggs inside the victim, upon which the larvæ feed at pleasure. The solitary wasps stock their brood cells in advance with whole spiders or insects. Some of the social species comminute or mangle their prey, and others, including many of the true ants, regurgitate the partly digested food material. The drivers probably feed dismembered pieces of their prey like the keleps. The kelep larvæ are not so completely helpless as those of bees and true ants, being provided with mouth parts adapted for eating out the soft interior tissues of insects, and long, flexible necks to enable them to reach inside and clean out the sections of boll weevils laid by the workers carefully on the fat stomachs of their baby sisters. Two such, lying side by side, each provided with a weevil's front leg to nibble, was the ludicrous sight observed in the nest of one of the captive colonies in Texas. Mrs. Cook has noted another instance of feeding which well illustrates the extent to which the social organization has developed in this respect.

A worker seized a termite as soon as it was dropped into the nest and held it in its jaws for fully five minutes, the termite vigorously protesting with its antennæ. After it was dead, or at least motionless, the kelep took it below where other workers assisted in feeding it to a large larva. It was very hard to get the termite properly placed; time and again it fell from where it had been put, and was turned over and twisted in all sorts of ways in the effort to bring it into a position so that the larva might take hold of its head. The larva meanwhile moved its own head back and forth, evidently trying to get hold on its own account, and a little larva near by did secure a hold on the other end of the termite, so that the keleps had to move both larva and termite in their further efforts to give the latter to the large larva. The little larva was almost as large as the termite. Finally the matter was arranged, the termite lying across the two larvæ, which remained peacefully side by side, the big one eating at the head, the little one at the tail. A worker had to take the head of the big larva between his jaws and fore legs and put it in contact with the termite, and then stood over it as though to see that the larva did its duty. The weight of the small larva kept pulling the termite off the body of the large larva before it had become firmly attached, so a worker stayed by and kept pulling the termite back in position. Finally the large larva got to work in earnest, and the faithful nurse left to help another kelep with another termite.

USE OF FIBERS IN CONSTRUCTION.

A possible reminiscence of an upper air existence by social ancestors of the kelep is to be found in a curious tube or gallery which is often constructed at the entrance of the nest to extend the underground passage upward on the stem of the cotton plant or other object to which the opening of the nest is adjacent. The workers always prefer to dig against something rather than in the open ground. The tubular structure in question may be only an inch or less in length, but it sometimes extends upward for 5 or 6

inches. It is built of shreds of woody material, bark, fibers, or even of cotton lint, sometimes with pellets of earth intermingled, but usually thin and with something of the papery texture and appearance of a wasp's nest. The object of this curious structure has not been determined with certainty. In some situations it serves the purpose of keeping the loose earth from falling into the burrow and may afford protection against enemies of some kind as yet unknown. After the tube has been built the insects seem reluctant to crawl over it to the ground outside. They even carry the pellets of earth brought out of the burrow up the stem of the plant and far out on the branches, and then drop them off.

STINGING HABITS OF THE KELEP.

The most obviously wasp-like habit of the kelep is, of course, the adroit stinging of its prey to produce paralysis and consequent helplessness. It has long been known that the mud daubers and the digger wasps stock their brood cells in advance with paralyzed insects or spiders, though very few of them are known to attack beetles. The insects are permanently paralyzed, but not killed outright, and afford the young wasps an adequate supply of fresh food on which to grow to maturity before emerging from the cell in which the egg was deposited by the mother insect. It has been claimed by some observers that paralysis results because the insects captured by the wasps are always stung in a nerve ganglion. This extreme refinement of instinct is doubted by some, but seems to have been established by careful observers.

In dealing with the boll weevil there can be no doubt that the kelep shows great instinctive skill, and often persistence as well, for the armor of the weevil permits the insertion of the sting at only two points—on the middle line of the ventral surface, at the two joints of the body, one between head and thorax, the other between the two parts of the thorax. The difference in the use of the sting between the keleps and the true ants is most effectively shown when representatives of the two groups are brought together and permitted to fight. The ant tries to bite its antagonist, the kelep to sting and paralyze, the latter strategy being much more effective.

This habit of stinging other insects allies the kelep not only with the predaceous wasps, but also with the Mutillidæ and other parasitic groups, which, instead of preying on other insects or storing them up for their young, lay their eggs in the living insect direct or in the nests of the social Hymenoptera. The stings of the worker bees and ants are, as is well known, merely modified ovipositors. The males do not have stings, and the tendency to use them is generally less in the queens, in which the egg-laying function remains predominant.

Contrasts between the kelep and the true ants also appear in connection with the sting. The kelep, which has an effective sting for use on other insects, does not make it a weapon for general defense against intrusion. The ants, on the other hand, fight each other with their mandibles, but many of them sting viciously at any foreign object with which they may come in contact. Curiously enough, too, many ants in which the sting has become a mere harmless rudiment still go through the motions of stinging with as much promptness and apparent gusto as their more effectively armed relatives. The decline of the sting among some of the ants may be associated perhaps with the fact that they are vegetable feeders. At least, it would seem to be an indication of their remoteness from the parasitic groups of Hymenoptera.

HARMLESSNESS OF THE KELEP TO MAN.

Lest the present recognition of the similarity of the kelep to the bees and wasps should lead to another misapprehension, it may be well to repeat here the fact that the insect is entirely harmless to man. Its sting is used with instinctive promptness to paralyze boll weevils and other insects which it undertakes to capture, but there seems to be a complete lack of any tendency to defend itself by stinging, except when actually caught and held.

This has been shown to the entire satisfaction of all who have had the interest to watch the kelep colonies which were brought to the United States in July (1904). The insects have been handled on many occasions, and by many different persons, without any threat or symptom of stinging, except in the case of two or three young men at Victoria, Tex., who had the curiosity to make a test of the injury which the insect's venom could inflict. The result was quite the same as we had experienced in Guatemala, a slight and temporary irritation. Messrs. Goll and Collins, who recently excavated the nests of about 40 colonies in Guatemala, were not stung at all, though taking no measures to protect themselves.

That an insect which is so ready and skillful in stinging its prey should be so peaceable and harmless in other respects may well appear almost incredible, but a similar specialization of instinct is known to exist in the domestic honeybee, where the queen has no inclination to use her sting except for the purpose of dispatching her rivals.[a]

[a] "But though this sting is always ready to strike, though they make constant use of it in their fights among themselves, they will never draw it against a queen; nor will a queen ever draw hers on a man, an animal, or an ordinary bee. She will never unsheath her royal weapon—curved, in scimiter fashion, instead of being straight, like that of the ordinary bee—save only in the case of her doing battle with an equal—in other words, with a sister queen."—Maeterlinck, M., 1901, The Life of the Bee, 100.

ADAPTABILITY OF KELEP ORGANIZATION TO AGRICULTURAL PURPOSES.

It is plain that the size attained by the colonies and the fecundity of the individual queens by no means determine the rate of increase possible for such an insect as the kelep. A social economy which provides for an indefinite increase of the numbers of colonies and of laying queens may more than compensate for the absence of the exceptional productiveness of the queens of the termites and the true ants. The marvelous fecundity of the females in these groups is, indeed, to be looked upon as an adaptive specialization by which the species is able to maintain an existence in spite of adherence to a most wasteful social policy, in which so much is staked on the vicissitudes of a simultaneous annual emergence of all the young and unprotected individuals of both sexes. This precarious period in the life history of the ants has been well described by Professor Wheeler.

> The sexual individuals, when finally liberated from the nests, are thrown on their own resources, and for a time the struggle for existence sets in with great severity. One has an opportunity of actually witnessing both catastrophic and personal elimination, often on a magnificent scale. The struggle among the males for the possession of the females is intense. The lives even of the fortunate among the former are rapidly extinguished. The surviving fecundated queens set to work to establish their colonies, an arduous and complicated undertaking, which ruthlessly eliminates all the poorly equipped. Even before they can dig their nests hundreds of these insects are devoured by birds, lizards, spiders, etc. And many more of them die from exhaustion while digging their nests, or from hunger while raising their first litter of young, or from the attacks of subterranean predatory insects, parasitic fungi, etc. This struggle, however, terminates on the appearance of the first workers, and the successful queens thenceforth again lapse into a condition of domestication till the close of their often very long lives.[a]

The contrast can best be expressed, perhaps, by saying that the social system followed by the termites and true ants involves the loss of nearly all of the females, while in that of the keleps all females are, or may be, saved and utilized in the increase of the species. There is nothing to show that the very large colonies of the ants and termites are an arrangement advantageous to the species as a whole. They are rather the result of the failure of these insects to adopt the habit of swarming, as practiced by the honeybee and the kelep.

From the agricultural standpoint, too, the superiority of the kelep organization is obvious. The division of the species into small bands enables the insects to spread uniformly over the fields, while large isolated ant-hills inhabited by hostile colonies would exclude the possibility of an efficient protection of all the cotton. The hills and pit-

[a] Wheeler, W. M., 1902, Science, n. s., 15: 769.

falls made by many ants would be a serious inconvenience in the cultivation of the crop. To avoid them would be difficult, and to drive over or plow through them would mean the wholesale destruction of the insects, so that the utilization in agriculture of a true ant-hill ant might well be deemed improbable. The social organization of the kelep avoids all of these difficulties. The colonies are small, but not hostile, so that all the plants of the field can be visited. Instead of an ant-hill and a maze of underground passages, they have a simple burrow, deep enough to give them protection against injuries incidental to ordinary cultivation. If the entrance is accidentally closed the inhabitants can readily reopen it; and if the situation proves to be inconvenient the whole community generally has the intelligence to move over close to the cotton plants, on which it regularly forages for nectar and game.

SUMMARY.

In summarizing the former report, of July, 1904, the investigation of the kelep was divided into five phases or questions, upon three of which evidence was submitted, while two others remained unconsidered. The three facts which seemed to be established were:

(1) The kelep protects the cotton plant against the boll weevil, which it regularly kills and eats. In the presence of sufficient numbers of keleps the protection is entirely adequate, as shown by comparative field tests in Guatemala. The keleps have made it possible for the Indians to maintain a field culture of cotton in the presence of the weevil, and have thus enabled the Indian variety of cotton to develop weevil-resisting characters which give partial protection, even in places where the keleps are few or wanting.

(2) The kelep does not attack plants, or have any other habits which would make its introduction into the United States injurious or undesirable.

(3) It is feasible to bring colonies of the insects to Texas and establish them in the cotton fields.

The continued study of the insect has furnished, of course, many additional data bearing upon the above statements, but all have been of a confirmatory nature. The present paper deals with the further question, whether the habits of the insect will enable it to breed and multiply in captivity or as a domesticated inhabitant of the cotton fields of our Southern States. From the analogy of the habits of the ants, it appeared to specialists in the study of that group of insects that the kelep could not be applied to agricultural uses. The facts detailed in the present paper seem to warrant a different answer.

(4) The kelep is not a true ant, but has a distinct type of social organization, much more like that of the domestic honeybee.

The utility of the kelep will depend, therefore, upon the answer of the remaining question, whether the kelep can survive and multiply under conditions of climate, soil, and food supply to be found in the United States. In structure, habits, and instincts it is wonderfully adapted to the work of destroying the cotton boll weevil.

It is, in short, a new and efficient insectivorous animal, in all probability capable of being utilized for the protection of cotton and other crops in many tropical and subtropical regions, whatever may be the results of the present effort to naturalize it in Texas.

It is still impossible to predict the fate, in a new country, of an insect which has so recently become an object of scientific study, but whatever the experiments may ultimately show regarding its ability to become established and thrive in the United States, it seems certain that the social organization of the species does not disqualify it for a future of agricultural utility. To prejudge its prospects by reference to the habits of the true ants would be the same kind of error as to discredit the honeybee on the ground that the bumblebees and wasps are worthless and undesirable insects.

Recent advices from Texas, received just as this paper is being completed, seem to indicate that the colonies which have been left out in the open ground of the cotton fields, without care or food, will not survive the winter, though they have lived long enough to show that low temperature alone is not fatal, thus confirming the result of a cold-storage experiment made in Washington last August (1904). As already explained in the present paper, the colonies of the first importation were far too small to make the experiment a fair one, and they were planted in Texas after the middle of July (1904), much too late in the season. A knowledge of the social organization of the insect will permit these and other obstacles to be avoided in the importations to be made in the coming spring (1905), and it is hoped that a satisfactory and conclusive test will result.

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L. O. HOWARD, Entomologist and Chief of Bureau.

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PREPARED UNDER THE DIRECTION OF THE ENTOMOLOGIST

BY

D. W. COQUILLETT,

Assistant Entomologist.

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TECHNICAL SERIES, No. 11.

U. S. DEPARTMENT OF AGRICULTURE,

BUREAU OF ENTOMOLOGY.

L. O. HOWARD, Entomologist and Chief of Bureau.

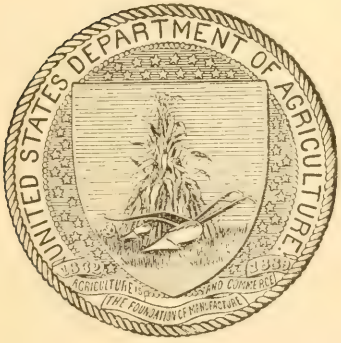
A CLASSIFICATION OF THE MOSQUITOES OF NORTH AND MIDDLE AMERICA.

PREPARED UNDER THE DIRECTION OF THE ENTOMOLOGIST

BY

D. W. COQUILLETT,

Assistant Entomologist.



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LETTER OF TRANSMITTAL.

U. S. Department of Agriculture,
Bureau of Entomology,
Washington, D. C., March 15, 1906.

Sir: I have the honor to submit a manuscript entitled "A Classification of the Mosquitoes of North and Middle America," prepared by Mr. D. W. Coquillett, assistant entomologist. The Department so frequently receives requests for information concerning this subject from students of entomology, from physicians, and from persons engaged in sanitary work that the desirability of an explicit publication on this subject is very obvious. I therefore urge that the manuscript be published as Technical Series, No. 11, of this Bureau.

Respectfully,

L. O. Howard,
Entomologist and Chief of Bureau.

Hon. James Wilson,
Secretary of Agriculture.

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FIG. 1. Wing of *Culex pipiens*, with names of veins, cells, etc 8

A CLASSIFICATION OF THE MOSQUITOES OF NORTH AND MIDDLE AMERICA.

INTRODUCTION.

In the following pages all of the subfamilies, genera, and species of mosquitoes known at the present time to occur in North and Middle America are briefly described or mentioned. In several instances, where the species have been founded chiefly upon larval characters, the adults have not been differentiated in the present work, owing to the fact that the cast larval skins were turned over to a second person before they were identified and associated with the bred adults. It was thought best, however, to publish this work in its present incomplete form, so that students might avail themselves of it at the commencement of the mosquito season. The greater number of these species were founded upon one or two specimens only, so that the range of variation in the adult stage could not be ascertained by the original describers.

During the summer of 1905 Dr. L. O. Howard examined the type specimens of several of Wiedemann's species in the Natural History Museum at Vienna, Austria, and with the aid of Dr. Anton Handlirsch, supplemented by a series of questions by the writer and a collection of named specimens for comparison, was able to gather some very important information in regard to those species which occur in North and Middle America. The museum collection was found to be in good condition, and type specimens were indicated by red labels. Following is a list of the species examined, with the results obtained by Doctor Howard:

Anopheles albimanus. The type agreed well with specimens of *Anopheles albipes* Theobald.

Anopheles crucians. The writer had correctly identified this species.

Anopheles ferruginosus. This was not a new species but simply a change of name for *Culex quinquefasciatus* of Say. It is represented in the Vienna museum by four specimens of a *Culex;* this is in perfect accord with Say's statement that the legs of this species are much shorter than those of *Anopheles punctipennis.* His other statement, namely, that it was an exceedingly numerous and troublesome species on the Mississippi River in May, considered in connection with the characters and measurements given in the descriptions of both Say and Wiedemann, seem to indicate that it can be no other than the common and widespread *Culex pipiens.*

Culex fatigans. The female has simple tarsal claws and the petiole of the first submarginal cell is about one-third as long as the cell.

Culex molestus. This is identical with *Psorophora ciliata* Fabricius.

Culex posticatus. The type has the last two joints of the hind feet wholly white; *Janthinosoma musica* Say is a synonym. The *Janthinosoma posticata* of Theobald, in which the last joint of the hind feet is white, is therefore a different species, for which the writer proposes the name **terminalis.**

Culex pungens. Three specimens from New Orleans, La. The claws are apparently simple, the scales of the wings are wholly brown, and the petiole of the first submarginal cell is from one-sixth to one-fifth as long as the cell. It is evidently identical with *pipiens.*

Culex taeniatus. A badly rubbed specimen of each sex from Savannah, Ga. It is synonymous with *Stegomyia calopus* Meigen.

Culex taeniorhynchus. The writer had correctly identified this species.

The most important changes resulting from this critical examination of the types are that the name *albimanus* replaces *albipes*, and *posticatus* takes precedence over *musica*, on account of priority in the publication of the original descriptions.

In the preparation of the present work it has been the constant aim of the writer to render it intelligible to the average student and observer by dispensing with the use of all technical terms so far as

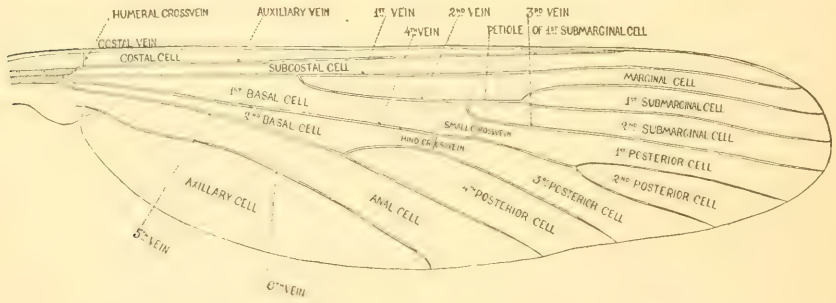

FIG. 1.—Diagram of the wing of a mosquito (*Culex pipiens*), with names of veins, cells, etc. (original).

this could be done without sacrificing either accuracy or clearness. A few terms, however, which could not be avoided, will need an explanation; these relate chiefly to the veins and cells of the wings, and it is believed that they will be made plain by reference to the accompanying illustration (fig. 1). The petiole of a cell is the last section of the vein before it forks to form the cell. The segments of the abdomen and the joints of the feet and antennæ are numbered from the point of attachment outwardly; thus, the large bulbous joint of the antennæ which is attached to the head is the first joint, the one next to it is the second, and so on. The scutellum is the semicircular piece at the posterior end of the upper part of the thorax, from which it is separated by a transverse suture. The remaining terms will no doubt be readily understood by the average reader.

In the tables of subfamilies and genera given on subsequent pages of the present work these groups are arranged in their systematic sequence, but no attempt of this kind has been made in the tables of the species. In the lists of species the synonyms are indented.

THE SUBFAMILIES OF THE CULICIDÆ.

The family Culicidæ was founded by Latreille in the year 1825. He did not consider it as representing a higher group than a tribe. Only the long-billed forms were known to him. The short-billed forms were erected into a distinct group, Corethrinæ, equivalent to a family, by the Italian naturalist Rondani in the year 1856. Schiner, in 1864, regarded the Corethrinæ as being only a subfamily of the family Culicidæ, and this view has been quite generally adopted by later writers. In the year 1883 Brauer proposed to include in this family the genus *Dixa*, which Schiner, fifteen years previously, had made the type of a new family, the Dixidæ. Dyar, in 1905, proposed to unite the Dixidæ with the Corethrinæ, the two groups to form one family, distinct from the Culicidæ.

That these three groups, the Dixidæ, Corethrinæ, and Culicinæ, are closely related to each other admits of no doubt. That the Corethrinæ are much more closely related to the Culicinæ than they are to the Dixidæ is also very evident. Thus the larva of the latter is provided with a pair of fleshy anal prolegs, a structure found in some of the Chironomidæ, but never present in any of the known larvæ of the Corethrinæ nor of the Culicinæ. In the adults the auxiliary vein in the Dixidæ ends at a point opposite the root of the second vein; in the other two groups it is prolonged nearly one-half of its entire length beyond the root of the second vein. In the Dixidæ the posterior margin of the wings is provided with hairs only; in the other two groups it is fringed with scales. Again, in the Dixidæ the antennæ are almost bare, and are similar in the two sexes; in the Culicinæ, with a single exception, and in the Corethrinæ these organs bear many long hairs, which, with few exceptions, are longer and much more numerous in the male than in the female. It will thus be seen that the Dixidæ are sufficiently distinct to be maintained as a separate family.

The radical difference in the structure of the mouth parts in the adults of the other two groups, added to the equally great difference in the food habits of the females, renders highly desirable their separation into distinct families, and we can do no better than to follow the lead of Rondani and consider that the short-billed forms constitute a family by themselves, the Corethridæ. With these forms eliminated, the family Culicidæ becomes a very homogeneous group, characterized by long, slender antennæ composed of fourteen or fifteen joints; a greatly elongated, slender proboscis; the presence of scales

on the wing veins; ten veins and subdivisions of veins which reach the margin of the wings and a vein along the posterior margin; and by the absence of a discal cell and of spurs at the apex of the inner side of the tibiæ.

In the family Culicidæ as thus restricted Theobald in the year 1901 erected the following five subfamilies: Anophelinæ, Megarhininæ, Culicinæ, Aëdeomyinæ, and Trichoprosoponinæ. The Aëdeomyinæ were separated from the Culicinæ by the much shorter palpi of the male. This appeared to be a natural division so long as there were known only forms wherein the palpi of the male in the one group are at least as long as the proboscis, while in the males of the other group they are less than one-fifth of this length; but the recent discovery of forms in which the male palpi are in one case one-third as long and in the other nearly one-half as long as the proboscis, greatly weakens the supposed importance of this difference in the relative length of the male palpi. Moreover, both as regards the larva and the structure of the tarsal claws and shape of the scales in the adults, some of the forms with short palpi in the male are much more closely related to species with long palpi in the male than they are to any of the others of the group with short palpi. These two divisions are thus seen to be unnatural and the two proposed subfamilies, namely, Culicinæ and Aëdeomyinæ, should therefore be merged into one.

In the year 1904 Lahille separated out the genus *Uranotænia* as the type of a distinct subfamily which he named Uranotænina, giving as its principal distinguishing character the great elongation of the petiole of the first submarginal cell and the consequent shortening of this cell; the larva has the four tufts near the middle of the head represented by stout spines which are covered with spinules. Lutz, in the same year, erected four supposed new subfamilies: Hæmagogina, Aëdinæ, Hyloconopinæ, and Dendromyinæ: the first of these belongs to the Culicinæ as above constituted, the second is a mixture of three subfamilies having short palpi in both sexes and the posterior end of the thorax bare, while the Hyloconopinæ and Dendromyinæ will fall as synonyms of Trichoprosoponinæ.

Very recently, in the early part of the present year (1906), Miss E. G. Mitchell erected two additional subfamilies: Psorophorinæ and Deinoceritinæ. The first was founded on the genus *Psorophora*, previously placed in the Culicinæ, but which, according to the habits of the larva, and the structure of its mouth parts, is much more closely related to the Megarhininæ. The second subfamily was founded on the genus *Deinocerites*, which differs radically from all the other members of the Culicidæ, not only in the structure of the mouth parts, particularly the mandibles, of the larvæ, but also in the antennæ of both sexes in the adults.

The following table exhibits the relationships and differences existing in the various subfamilies of the family Culicidæ at present known to occur in North and Middle America; the latter term, as employed by Jordan and Evermann in their admirable work on the fishes of this region, is intended to include Mexico, Central America, and the West Indies. There are characters in the eggs and larvæ also which support the differentiation of these subfamilies, but these are not given here, since the larvæ will be considered in another publication of this Bureau:

TABLE OF THE SUBFAMILIES.

A. Scutellum convex behind, never distinctly three-lobed; posterior end of the thorax bare; small crossvein usually situated considerably before the root of the third vein and connected with it by a stump of a vein; claws of the female simple.

B. Proboscis straight or almost so; back of the head devoid of broad appressed scales, but with many narrow outstanding ones; body never with metalescent scales; first submarginal cell longer than its petiole; claws simple in both sexes.

1. ANOPHELINÆ (p. 12)

BB. Proboscis strongly decurved; back of the head wholly covered with broad appressed scales, but devoid of narrow, outstanding ones; body covered with broad appressed metalescent scales; first submarginal cell less than half as long as its petiole; some of the claws of the male toothed.

2. MEGARHININÆ (p. 14)

AA. Scutellum distinctly three-lobed; small crossvein usually situated beyond the root of the third vein.

C. Posterior end of the thorax bare.

D. First submarginal cell at least nearly as long as its petiole; some of the claws of the male toothed; thorax never with metallic bluish scales arranged in lines or spots.

E. Second joint of the antennæ less than eight times as long as wide in both sexes, with many long hairs, longer and more numerous in the male.

F. Femora bearing many outstanding scales; wing scales narrow.

3. PSOROPHORINÆ (p. 14)

FF. Femora devoid of outstanding scales[a]. 4. CULICINÆ (p. 15)

EE. Second joint of the antennæ unusually long, in both sexes over fourteen times as long as wide; antennæ in both sexes with a few short hairs only.... 5. DEINOCERITINÆ (p. 26)

DD. First submarginal cell less than half as long as its petiole; claws simple in both sexes; thorax with metallic bluish scales which form lines or spots..... 6. URANOTÆNIINÆ (p. 26)

CC. Posterior end of the thorax behind the scutellum bearing several bristles and sometimes with a few scales; claws simple in both sexes; antennæ similar in the two sexes, bearing many long hairs..... 7. TRICHOPROSOPONINÆ (p. 26)

[a] Except in the genus *Ædeomyia*, which has broad wing scales.

1. Subfamily ANOPHELINÆ Theobald.

TABLE OF THE GENERA.

1. Abdomen with clusters of broad, outstanding scales along the sides; outstanding scales on the veins of the wings chiefly rather broad 4
   Abdomen never with such clusters of scales 2
2. Outstanding scales on the veins of the wings lanceolate, or broader, strongly tapering to their bases 3
   Outstanding scales very narrow, linear, very slightly, if at all, tapering to their bases; feet with white bands. (Middle America.) ..... *Myzomyia.*
3. Veins of the wings having the outstanding scales rather narrow, lanceolate; feet wholly black ..... *Anopheles.*
   Veins of the wings with many broad, obovate, outstanding scales; feet with narrow, indistinct white bands at the bases of some of the joints. (Middle America.) ..... *Cyclolepteron.*
4. Upper side of thorax and scutellum bearing many appressed lanceolate scales; outstanding scales on the veins of the wings rather narrow, lanceolate. (Florida and southward.) ..... *Cellia.*
   Upper side of thorax and scutellum with hairs only; many rather broad, obovate, outstanding scales on the veins of the wings. (Middle America.)
   Nototricha n. gen.

Genus MYZOMYIA Blanchard.

(Synonym: *Grassia* Theobald.)

Wings black-scaled and with several white-scaled patches; feet black, banded with white; thorax gray and with four black stripes. (West Indies.)
lutzii Theob.

Genus ANOPHELES Meigen.

(*a*) TABLE OF THE SPECIES.

1. Wings marked with spots of dark or light-colored scales 2
   Wings unspotted; length of the head and body about 3 mm ..... *barberi* Coq.
2. Front margin of the wings with a patch of whitish scales at a point about three-fourths of the way from base to apex of the wing 5
   Front margin of the wings wholly black-scaled 3
3. Sixth, or last, vein of the wings wholly black-scaled 4
   Sixth vein white-scaled and with three patches of black scales ..... *crucians* Wied.
4. Hind tibiæ yellowish-white-scaled on the apical fourth; first vein of the wings with a patch of yellow scales before its middle and another on the apex. (Central America.) ..... *ciscui* Coq.
   Hind tibiæ narrowly yellowish-white-scaled at the extreme apex only, first and other veins with black scales only ..... *maculipennis* Meig.
5. Scales of the last vein of the wings white, those at its apex black; third vein white-scaled and with two patches of black scales 6
   Scales of the last vein white, those at each end black; third vein black-scaled, the extreme apex white-scaled ..... *punctipennis* Say.
6. Fourth vein of the wings black-scaled, the apices of the forks and usually also a patch at the cross veins white-scaled ..... *franciscanus* McC.
   Fourth vein white-scaled, the forks (except their apices) and on either side of the cross veins black-scaled ..... *pseudopunctipennis* Theob.

(*b*) List of the Species and Synonyms.

barberi Coq.
crucians Wied.
eiseni Coq.
franciscanus McCracken.
maculipennis Meig.
annulimanus van der Wulp.[a]
bifurcatus Meigen (1804; not of Linné, 1758).
quadrimaculatus Say.
pseudopunctipennis Theob.
punctipennis Say.
hyemalis Fitch.

(*c*) Unrecognized Species.

bifurcatus Linné, *nigripes* Stæger, and *walkeri* Theobald. These species are said to have unspotted wings, like *barberi*, but are larger, have yellow scales on the thorax, etc.

pictus Loew. This species, described from Asia Minor, was also recorded from North America by its author, but he evidently mistook some other species for it. No specimen of his species has been reported from this country since the time he published the statement.

quinquefasciatus Say (*ferruginosus* Wied.). This is a synonym of *Culex pipiens* L.

Genus CYCLOLEPPTERON Theobald.

Thorax with a velvety black dot near the middle of either side; feet almost unicolorous, not distinctly banded; wing scales chiefly brown or black, a patch of yellow ones at a point about two-thirds the length of the front margin and four smaller ones at the apex of the wing ..... *grabhami* Theob.

(*C. mediopunctatus* Theob. belongs to the following genus.)

Genus NOTOTRICHA, new genus.

Thorax with a velvety black dot near the middle of either side and a larger spot in front of and extending upon the scutellum; legs brown-scaled and with many dots and narrow bands of light-colored scales ..... *mediopunctata* Theob.

Genus CELLIA Theobald.

(Synonym: *Arribalzagia* Theobald.)

(*a*) Table of the Species.

1. Hind feet from the middle of the second joint largely or wholly snow-white 2
   Hind feet black, mottled with whitish and with bands of the same color at the sutures of the joints ..... *maculipes* Theob.
2. With a black band at the base of the last joint of each hind foot .. *albimanus* Wied.
   Without such a band ..... *argyritarsis* Desv.

(*b*) List of the Species and Synonyms.

albimanus Wied.
albipes Theob.
cubersis Agramonte.
tarsimaculatus Goeldi.
argyritarsis Desv.
albitarsis Arrib.
maculipes Theob.

[a] At my request Dr. C. Ritsema Cz compared specimens of *maculipennis* with the type of *annulimanus* in the Leyden Museum, and informed me that they are identical.

2. Subfamily MEGARHININÆ Theobald.

(Synonym: *Lynchiellina* Lahille.)

Genus MEGARHINUS Desvoidy.

(Synonym: *Lynchiella* Lahille.)

(*a*) Table of the Species.

1. Feet with a white band, at least on the hind ones; middle joint of the male palpi with many yellow scales on the outer side; hairs of the male antennæ long and dense 2
   Feet wholly black on at least their upper side; palpi wholly purple-scaled; hairs of the male antennæ rather short and sparse. (West Indies.) ..*violaceus* Wied.
2. Middle and front feet wholly black .....*portoricensis* Roeder.
   Middle and usually the front feet with a white band on each .....*rutilus* Coq.

(*b*) List of the Species and Synonyms.

portoricensis Roeder.
  ferox Walker (not of Wiedemann).
rutilus Coq.

violaceus Wied.
  purpureus Theob.

(*c*) Unrecognized Species.

grandiosus Will., *hæmorrhoidalis* Fab., and *longipes* Theob. These three species have been reported from Mexico.

3. Subfamily PSOROPHORINÆ Mitchell.

Genus PSOROPHORA Desvoidy.

(Synonym: *Chrysoconops* Goeldi.)

(*a*) Table of the Species.

1. Abdomen yellow or brownish, its scales yellowish 3
   Abdomen black, its scales chiefly purple; upper side of the thorax polished black, usually white-scaled toward the sides 2
2. Front and middle femora black, their scales purple except at the narrow apex of each femur, where they are white. (Middle America.) .....*cilipes* Fab.
   Front and other femora yellow, yellow-scaled, their broad apices black-scaled. *howardii* Coq.
3. Veins in the front half of the wings, except toward their apices, deep yellow, their scales of the same color, scales on the front half of the thorax golden yellow. (West Indies.) .....*fulva* Wied.
   Veins and scales of the wings wholly brown, scales in the middle of the upper side of the thorax golden yellow, those toward the sides white .....*ciliata* Fab.

(*b*) List of the Species and Synonyms.

ciliata Fab.
  conterrens Walk.
  molestus Wied.
  perterrens Walk.
  rubidus Desv.
cilipes Fab.

fulva Wied.
  flavicosta Walk.
  ochripes Macq.
howardii Coq.

(*c*) Unrecognized Species.

scintillans Walk. This species has been recorded from the West Indies.

4. Subfamily CULICINÆ Theobald.

(Synonyms: *Ædeomyinæ* Theobald, *Hæmagoginæ* Lutz.)

Table of the Genera.

1. Claws of the female toothed on at least the front and middle feet; some of the claws of the male also toothed 4
   Claws of the female simple 2
2. Palpi of the male at least three-fourths as long as the proboscis 10
   Palpi of the male at most only one-half as long as the proboscis. (Middle America.) 3
3. Head posteriorly with very narrow scales and with a patch of broad ones on each side 18
   Head sparsely or densely covered with broad scales posteriorly 21
4. Scales along the sides of the upper surface of the thorax narrow, almost linear, legs never with outstanding scales 6
   Scales along the sides of the upper surface of the thorax chiefly rather broad, obovate, hind part of the head with many similar scales scattered about 5
5. Legs devoid of outstanding scales ..... *Lepidosia.*
   Legs bearing many outstanding scales, at least on the hind feet, all feet black, the hind ones alone partly white ..... *Janthinosoma.*
6. Back part of the head densely covered with broad, appressed scales except sometimes a narrow stripe in the middle 7
   Back part of the head sparsely covered with narrow, almost linear scales and with a patch of broad ones on each side 8
7. Clypeus bearing several scales or hairs, scutellum with broad scales only. *Stegomyia.*
   Clypeus bare, scutellum with narrow scales only. (Middle America.) .. *Verrallina.*
8. Wing veins having the outstanding scales narrow, lanceolate, only slightly tapering to the base 9
   Wing veins having many very broad outstanding scales which taper strongly to their bases; several of the scales are hollowed out at their apices. *Lepidoplatys.*
9. Palpi of the male less than one-fourth as long as the proboscis ..... *Aedes.*
   Palpi of the male about as long as the proboscis ..... *Ochlerotatus.*
10. Head densely covered behind with broad, appressed scales, except a narrow stripe in the middle, or else the thorax has six lines of silvery scales 23
    Head bearing narrow, almost linear appressed scales behind and with a patch of broad ones on each side; thorax never with lines of silvery scales 11
11. Outstanding scales on the veins behind the first one narrow and of nearly a uniform width 12
    Outstanding scales on at least the apical half of the wings broad, considerably narrowed at their bases 17
12. Feet white at each end of some of the joints, or else wholly black, in which case the abdomen is wholly black-scaled, or else it has cross bands of light-colored scales 13
    Feet white at the bases only of some of the joints, or else wholly black, in which case the abdomen is black-scaled and with the front corners of some of the segments white-scaled ..... *Grabhamia.*

13. Costa of the wings not spotted 14
Costa black-scaled and with three large spots of pale yellow scales. (Middle America.) ..... *Lutzia.*
14. Thorax with two distinct bare stripes near the middle of the upper side; hind cross vein at least its own length from the small cross vein ..... *Culicella.*
Thorax without bare stripes 15
15. Scales of the wings collected into spots; hind cross vein much less than its length from the small cross vein ..... *Theobaldia.*
Scales of the wings uniformly distributed 16
16. Hind cross vein much less than its own length from the small cross vein. *Culiseta.*
Hind cross vein situated at least nearly its own length from the small cross vein ..... *Culex.*
17. Basal half of the wings having the outstanding scales of the veins narrow and almost linear; proboscis wholly black ..... *Melanoconion.*
Basal half of the wings having many broad, outstanding scales on the veins. 20
18. Wing veins having the outstanding scales narrow, almost linear 19
Wing veins having the outstanding scales rather broad, oblanceolate; palpi of the male almost one-half, those of the female less than one-fifth, as long as the proboscis ..... *Tinolestes.*
19. Palpi in both sexes about one-third as long as the proboscis ..... *Micraëdes.*
Palpi in both sexes less than one-fifth as long as the proboscis. *Isostomyia* n. gen.
20. The outstanding scales on the veins of the wings only moderately broad, over twice as long as broad, their apices rounded; proboscis and feet usually with light-colored bands ..... *Taeniorhynchus.*
The outstanding scales chiefly unusually broad, their apices flat or hollowed out ..... *Mansonia.*
21. Outstanding scales on the wing veins unusually broad; femora toward their apices bearing several elongate, outstanding scales; body devoid of blue scales. *Aëdeomyia.*
Outstanding scales on the wing veins narrow, almost linear, legs devoid of outstanding scales, head and body chiefly blue scaled 22
22. Base of the first submarginal cell nearer to the base of the wing than is that of the second posterior cell; palpi of the male less than one-fifth as long as the proboscis, the abdomen bearing only a few hairs on the under side of the penultimate segment ..... *Haemagogus.*
Base of the first submarginal cell noticeably nearer to the apex of the wing than is the base of the second posterior cell; palpi of the male about one-half as long as the proboscis; abdomen of the male with a large cluster of outstanding, blunt spines on the under side of the penultimate segment ..... *Cacomyia* n. gen.
23. Scutellum bearing both broad and narrow scales; head behind covered with broad appressed scales except a median stripe of rather narrow ones; outstanding scales on the wing veins narrow. (Middle America.) ..... *Gymnometopa.*
Scutellum with narrow scales only 24
24. Back of the head covered with broad appressed scales except a median stripe of rather narrow ones; outstanding scales on the wing veins narrow. (Middle America.) ..... *Howardina.*
Back of the head with narrow scales only; many rather broad, outstanding scales on the wing veins ..... *Pneumaculex.*

Genus LEPIDOSIA Coquillett.

Our two species have the scales of the abdomen deep blue, except those of the first segment and a broad, usually interrupted band on the apices of the other segments, which are pale yellow or whitish.

Hind feet wholly black ..... *cyanescens* Coq.
Hind feet black, the last joint white ..... *mexicana* Bell.

Genus JANTHINOSOMA Arribalzaga.

(Synonym: *Conchyliastes* Theobald.)

(*a*) TABLE OF THE SPECIES.

1. Last two joints of the feet wholly white 3
   Last joint largely or wholly black, the preceding joint chiefly white 2
2. Scales on the upper side of the thorax yellow ..... *varipes* Coq.
   Scales brown, those toward the sides yellow ..... *discrucians* Walk.
3. Upper side of the thorax yellow-scaled and with a broad stripe of brown scales in the middle ..... *lutzii* Theob.
   Upper side of the thorax wholly yellow-scaled ..... *posticata* Wied.

(*b*) LIST OF THE SPECIES AND SYNONYMS.

discrucians Walker (not of Giles and Theobald).[a]
- *arribalzagæ* Giles.

lutzii Theob.
- *albitarsis* Neveu-Lemaire (not of Theobald).
- *discrucians* Giles and Theobald (not of Walker).

posticata Wiedemann (not of Theobald).
- *musica* Say.

varipes Coq.
- *johnstonii* Grabham.

(*c*) UNRECOGNIZED SPECIES.

terminalis Coquillett (*posticata* Theobald, not of Wiedemann), was described from St. Lucia, W. Ind., and differs from all of the other species in that the last joint only of the hind feet is white.

Genus STEGOMYIA Theobald.

(*a*) TABLE OF THE SPECIES.

Thorax marked with a pair of curved silvery stripes forming a figure which somewhat resembles a lyre; proboscis unicolorous black, feet black and with white bands at the bases of some of the joints ..... *calopus* Meig.

(*b*) LIST OF THE SPECIES AND SYNONYMS.

calopus Meig.
- *annulitarsis* Macq.
- *bancroftii* Skuse.
- *elegans* Ficalbi.
- *exagitans* Walk.
- *excitans* Walk.
- *fasciata* Fab.
- *formosa* Walk.
- *frater* Desv.
- *impatibilis* Walk.
- *inexorabilis* Walk.
- *konoupi* Brullé.
- *luciensis* Theob.
- *mosquito* Desv.
- *queenslandensis* Theob.
- *rossii* Giles.
- *tæniatus* Wied.
- *toxorhynchus* Macq.
- *viridifrons* Walk.
- *zonatipes* Walk.

(*S. sexlineata* Theob. belongs to the genus *Gymnometopa*.)

Genus VERRALLINA Theobald.

Upper side of the thorax black-scaled, the sides in front of the wings white-scaled. *insolita* Coq.
Upper side of the thorax wholly whitish-scaled ..... *laternaria* Coq.

[a] The form referred to this species by these two authors has the entire apex of the hind feet wholly white, whereas in his original description Walker expressly states, both in the Latin diagnosis and in the English description, that there is only a subapical white band in *discrucians*, the remainder of the feet being purple.

Genus LEPIDOPLATYS Coquillett.

(*a*) TABLE OF THE SPECIES.

Scales of the wings mixed brown and white; feet with broad white bands at the bases of some of the joints, tibiæ not distinctly banded ..... *squamiger* Coq.

(*b*) LIST OF THE SPECIES AND SYNONYMY.

squamiger Coq.
deniedmannii Ludlow.

Genus AËDES Wiedemann.[a]

Upper side of the thorax golden-yellow scaled; abdomen black-scaled and with a band of yellow scales at the bases of the segments; feet unicolorous black.
fuscus O. S.

(*A. smithii* belongs to *Wyeomyia.*)

Genus OCHLEROTATUS Arribalzaga.

(Synonyms: *Culicada* Felt, *Culicelsa* Felt, *Eeculex* Felt, *Protoculex* Felt, *Pseudoculex* Dyar.)

(*a*) TABLE OF THE SPECIES.

1. Ground color of the thorax bright yellow; the scales and bristles of the head and thorax wholly yellow 2
   Ground color of the thorax brown or black 3
2. With an ovate black spot above the insertion of each wing; feet not distinctly two-colored, claws of the hind ones simple ..... *bimaculatus* Coq.
   Without such a spot; feet dark colored and with white bands at the bases of some of the joints. (Middle America.) ..... *knabi* Coq.
3. Feet dark colored and with white bands 19
   Feet not distinctly banded, proboscis unbanded 4
4. Scales of the abdomen black, sometimes a crossband or pair of spots of light-colored scales on some or all of the segments 5
   Scales of the abdomen yellow, except a pair of spots of black ones on some of the segments; claws toothed on all of the feet in the female ... *spenceri* Theob.
5. Light-colored scales of the abdomen forming crossbands situated at the bases of the segments 6
   Light-colored scales, when present, forming spots on the sides of some of the segments 14
6. Upper side of the thorax yellow-scaled and with three stripes of brown scales; scales of the wings wholly brown; all the claws of the female toothed.
   trivittatus Coq.
   Upper side of the thorax not marked like this 7
7. Thorax with a brown-scaled stripe along the sides and with a wider space of white scales in the middle; scales of the wings wholly brown; all of the claws toothed in the female ..... *dupreei* Coq.
   Thorax not marked in this manner 8
8. Sides broadly and the front end of the thorax whitish-scaled; back part of the head also whitish-scaled; all claws toothed in the female 9
   Sides and front end of the thorax yellow or brown scaled 10
9. Middle of the thorax with a broad stripe of brown scales ..... *pretans* Grossb.
   Middle of the thorax having the scales yellow and whitish ... *cinereoborealis* Felt.

[a] This genus has commonly been credited to Meigen, but he expressly states that he had not seen a specimen and that both the name and description had been furnished to him by Wiedemann.

10. The scales in the middle of the thorax as dark as, or darker than, those along the side 11
The scales in the middle of the thorax yellow, those along the broad sides brown; claws of the hind feet simple in the female ..... *bracteatus* Coq.
11. Bristles of the scutellum yellow 12
Bristles of the scutellum chiefly black; upper side of the thorax golden-yellow-scaled and devoid of stripes of darker scales, although two darker stripes sometimes appear where the scales are very sparse, each stripe being scarcely one-half as wide as the yellow-scaled space between it and the other stripe. *pullatus* Coq.
12. In the middle of the thorax the scales are wholly yellow 13
In the middle of the thorax is a pair of brown-scaled stripes, each stripe being slightly wider than the yellow-scaled space between it and the other stripe. *lazarensis* F. & Y.
13. Claspers of the male with a long, stout spine near the base of the inner side. *impiger* Walk.
Claspers without such a spine ..... *abserratus* Felt.
14. With a median stripe of scales on the thorax of a different color from those along the sides 15
Without such a stripe; abdomen black-scaled and with the front angles of some of the segments white-scaled; claws on all of the feet of the female toothed. (Middle America.) ..... *nubilus* Theob.
15. Scales in the middle of the thorax, at least on its anterior half, white, the remainder brown; claws on all of the feet of the female toothed 16
Scales in the middle of the thorax black, the remainder yellow or whitish ... 18
16. Stripe of white scales in the middle of the thorax extending entirely across the latter 17
Stripe of white scales confined to the anterior two-thirds of the thorax. *confirmatus* Arrib.
17. White-scaled stripe of the thorax much narrower than the brown-scaled portion on each side of it ..... *serratus* Theob.
White-scaled stripe wider than the brown-scaled portion on each side of it. *dupreei* Coq.
18. Upper surface of the thorax white-scaled toward the sides; claws on the hind feet of the female simple ..... *triseriatus* Say.
Upper surface of the thorax golden-yellow-scaled toward the sides; claws on the hind feet of the female toothed ..... *aurifer* Coq.
19. Proboscis blackish and with a white band near the middle; white bands of the feet confined to the bases of the joints, except on the hind feet, the last joint of which is sometimes wholly white 20
Proboscis blackish, not distinctly banded near the middle 22
20. Abdomen black-scaled, each segment with a basal band and median longitudinal stripe of yellowish scales, and with a white-scaled spot in the middle of each side 21
Abdomen black-scaled, each segment with a band at the base and a spot in the middle of each side white-scaled, wing scales wholly black *taeniorhynchus* Wied.
21. Wing scales mixed black and yellowish; light colored scales of the legs yellow, usually a whitish band in the middle of the first joint of the feet *sollicitans* Walk.
Wing scales wholly black; light colored scales of the legs pure white, first joint of the feet never with a light colored band in the middle ..... *mitchellæ* Dyar.
22. Joints of the feet having the white bands situated at both ends of some of them, last joint of the hind feet white 23
Joints of the feet having the white bands situated at the bases only of some of them, last joint of the hind feet black except sometimes its extreme base .. 28

23. Black scales mixed with white ones on the wings; abdomen whitish or yellow-scaled and with a pair of black-scaled spots on some of the segments..... 24
Black scales only on the wings, abdomen black-scaled, sometimes with a band of white scales at the bases of the segments..... 25

24. Stripe of scales in the middle of the thorax deep golden brown, covering more than one-fifth of the width of the thorax, its borders well defined. (Salt water species.)..... *lativittatus* Coq.
Stripe pale brown, covering less than one-ninth of the width of the thorax, its borders not strongly marked, usually a narrow stripe of brown scales on each side of it separated by yellowish white scales. (Fresh water species.)
curriei Coq.

25. Upper side of the thorax light-yellow-scaled and with a broad stripe of black scales in the middle; palpi wholly black-scaled in both sexes; abdomen black-scaled and with a band of white scales at the base of each segment.
atropalpus Coq.
Upper side of the thorax not marked as above; palpi with whitish scales at the apices in the female and with bands of them in the male..... 26

26. Segments of the abdomen with distinct whitish bands at their bases; scales of the upper side of the thorax brown and light yellowish..... *varipalpus* Coq.
Segments of the abdomen never with distinct whitish bands; scales of the upper side of the thorax wholly yellow..... 27

27. Hind feet almost wholly white-scaled..... *nivitarsis* Coq.
Hind feet largely black-scaled..... *canadensis* Theob.

28. Dorsum of the abdomen black-scaled and with a band of light-colored scales at the base of each segment..... 30
Dorsum of the abdomen not marked as above..... 29

29. Abdomen wholly light-yellow-scaled..... *fletcheri* Coq.
Abdomen black-scaled and with white spots on the sides; thorax black-scaled and with four lines of yellow scales. (Middle America.)..... *quadrivittatus* Coq.

30. White band at the base of the second joint of the hind feet covering at least one-third of the length of the joint; claws of the hind feet toothed in the female.. 32
White band covering less than one-fourth of the length of the second joint of the hind feet..... 31

31. Seventh segment of the abdomen almost wholly yellow-scaled, many yellow scales in the central portion of the preceding segment; claws of the hind feet of the female simple..... *cantator* Coq.
Seventh and preceding segments chiefly black-scaled; claws of the hind feet of the female toothed..... *sylvestris* Theob.

32. Claspers of the male having, near the base of the inner side, a large process thickly covered with hairs..... *fitchii* Felt.
Claspers without such a process..... *subcantans* Felt, *abfitchii* Felt, *vittata* Theob.

(*b*) List of the Species and Synonyms.

abfitchii Felt.
siphonalis Grossb.
abserratus F. & Y.
atropalpus Coq.
aurifer Coq.
bimaculatus Coq.
bracteatus Coq.
cantator Coq.
canadensis Theob.
cinereoborealis F. & Y.[a]
trichurus Dyar.

[a] The writer's copy of Science containing the original description of this species was received September 2, 1904, and the National Museum copy is stamped as having been received on the same date. The writer's copy of the Journal of the New York Entomological Society which contains the original description of *trichurus* was received September 6, 1904; the National Museum copy and that of the U. S. Department of Agriculture are stamped with the same date—September 6, 1904.

(*b*) List of the Species and Synonyms—Continued.

confirmatus Arrib.
curriei Coq.
dupreei Coq.
fitchii F. & Y.
fletcheri Coq.
impiger Walk.
implacabilis Walk.
knabi Coq.
lativittatus Coq.
lazarensis F. & Y.
mitchellæ Dyar.
nivitarsis Coq.
nubilus Theob.
pretans Grossb.
pullatus Coq.
quadrivittatus Coq.
serratus Theob.
mathisi Neveu-Lem.
sollicitans Walk.
spenceri Theob.
idahoensis Theob.
subcantans Felt.
sylvestris Theob.
tæniorhynchus Wied.
damnosus Say.
triseriatus Say.
nigra Ludlow (*Finlaya*).
trivittatus Coq.
varipalpus Coq.
sierrensis Ludlow.

(*c*) Unrecognized Species.

aestivalis Dyar, *auroides* Felt, *excrucians* Walker, *hirsuteron* Theob., *inconspicuus* Grossb., *nemorosus* Meigen, *onondagensis* Felt, *pallidohirta* Grossb., *portoricensis* Ludlow, *provocans* Walker, *punctor* Kirby, *reptans* Meigen, *stimulans* Walker, *testaceus* van der Wulp, and *tortilis* Theobald.

Genus GRABHAMIA Theobald.

(Synonym: *Feltidia* Dyar.)

(*a*) Table of the Species.

1. Feet unicolorous brown, wing scales wholly brown. (West Indies.) 2
   Feet brown and with bands of white scales at bases of some of the joints 3
2. With an ovate, velvety-black spot above the insertion of each wing; abdomen black scaled, unmarked ..... *ocellatus* Theob.
   Without such a spot; abdomen black-scaled and with a white-scaled spot in the front angles of the posterior segments ..... *scholasticus* Theob.
3. Proboscis black scaled and with a light-colored band near the middle; a white band before the apex of each hind femur 4
   Proboscis wholly black; abdomen black-scaled and with a white band at the bases of the segments; no white band before the apex of the hind femora. (West Indies.) ..... *imitator* Theob.
4. Wing scales black and whitish 5
   Wing scales wholly black; abdomen black-scaled and with a narrow white, usually interrupted, band at apex of each segment. (West Indies.) *confinis* Arrib.
5. Last vein with many black scales on the basal portion 6
   Last vein wholly white scaled on the basal two-thirds; light and dark scales of the wings collected into spots, costa mixed black and whitish scaled and with a long whitish spot beyond the apex of the auxiliary vein ..... *discolor* Coq.
6. Costa and veins bearing mixed black and whitish scales, the latter not forming distinct spots 7
   Costa black and whitish scaled, the apical half with four long spots of whitish scales alternating with three long spots of black ones ..... *signipennis* Coq.
7. First joint of the hind feet light colored in the middle, a small but distinct black-scaled spot at the base of the third vein ..... *jamaicensis* Theob.
   First joint of the hind feet black in the middle, no distinct black spot at the base of the third vein ..... *pygmæus* Theob.

(*b*) List of the Species and Synonyms.

confinis Arrib.
discolor Coq.
imitator Theob.
jamaicensis Theob.
confinis auct. (all references to its occurrence in the United States).
ocellatus Theob.
pygmæus Theob.
antiquæ Giles.
nanus Coq.
scholasticus Theob.
signipennis Coq.

(*G. deniedmannii* Ludlow belongs to *Lepidoplatys.*)

Genus LUTZIA Theobald.

Joints of the feet white at each end, abdomen black-scaled and with a large apical spot of white scales on each segment ..... *bigotii* Bell.

Genus CULICELLA Felt.

(*a*) Table of the Species.

Feet narrowly white at the bases of some of the joints, proboscis without a lighter band near the middle, abdomen black-scaled and with a broad band of yellow scales at the base of each segment ..... *dyari* Coq.

(*b*) List of the Species and Synonymy.

dyari Coq.
brittoni Felt.

Genus THEOBALDIA Neveu-Lemaire.

(*a*) Table of the Species.

Front side of the hind tibiæ chiefly black-scaled, the apices very broadly whitish-scaled, white bands of the feet narrow, the dark spots on the wings large. *incidens* Thom.

Front side of the hind tibiæ with many yellow scales, the apices narrowly and indistinctly whitish-scaled; the dark spots on the wings small ..... *annulata* Schrank.

(*b*) List of the Species and Synonyms.

annulata Schrank.
affinis Stephens.
variegata Schrank.
incidens Thom.
particeps Adams.

Genus CULISETA Felt.

(*a*) Table of the Species.

Wing scales wholly brown, abdomen brown-scaled and with bands of light-colored scales at the bases of the segments in both sexes ..... *absobrinus* Felt.

Wing scales mixed brown and yellowish in the female, abdomen brown-scaled and with bands of light-colored scales in the female, unbanded in the male. *consobrinus* Desv.

(*b*) List of the Species and Synonyms.

absobrinus Felt.
consobrinus Desv.
impatiens Walk.
inornatus Will.
magnipennis Felt.
pinguis Walk.

Genus CULEX Linné.

(Synonyms: *Heteronycha* Arribalzaga, *Neoculex* Dyar.)

(*a*) Table of the Species.

1. Feet black, both ends of some of the joints white. *janitor* Theob., *pleuristriatus* Theob., *secutor* Theob., *tarsalis* Coq.
   Feet uniformly blackish 2
2. Light-colored bands of scales on the abdomen situated at the bases of the segments 3
   Light-colored bands located at the apices of the segments, sometimes almost wanting ..... *territans* Walk.
3. Upper side of the thorax dark-yellow-scaled, and usually with a small round dot of light-yellow scales on each side of the center; light-colored bands of the abdomen broad and distinct; feet with very narrow, indistinct bands of light-colored scales at the sutures of the joints ..... *restuans* Theob.
   Upper side of the thorax devoid of such dots 4
4. Crossbands of light-colored scales indistinct on the anterior half of the abdomen, almost wanting on the second segment ..... *salinarius* Coq.
   Crossbands distinct 5
5. Species from the West Indies ..... *palus* Theob.; *similis* Theob.
   Species almost cosmopolitan ..... *pipiens* Linné.

(*b*) List of the Species and Synonyms.

janitor Theob.
palus Theob.
pipiens Linne.
  boscii Desv.
  cubensis Bigot.
  fatigans auct.[a] (North American references).
  ferruginosus Wied. (*Anopheles.*)
  pungens Wied.
  quinquefasciatus Say.
pleuristriatus Theob.
restuans Theob.
salinarius Coq.
  nigritulus auct. (North American references).
secutor Theob.
similis Theob.
tarsalis Coq.
  affinis Adams (not of Stephens).
  kelloggii Theob.
  peus Speiser.
  willistoni Giles.
territans Walk.
  apicalis Adams.

(*c*) Unrecognized Species.

flaripes Macquart, *biocellatus* Theobald, *inflictus* Theob., *microsquamosus* Theob., *nigripalpus* Theob., and *saxatilis* Grossbeck.

(*C. penafieli* Williston has never been described.)

Genus MELANOCONION Theobald.

1. Hind and other feet wholly black 2
   Hind feet white-scaled on the broad base of the fourth joint; abdomen black-scaled, a row of violet-scaled spots along the sides. (Middle America.) *urichii* Coq.

[a] In response to my request, Maj. A. Alcock, superintendent of the natural history section of the Indian Museum at Calcutta, India, sent me specimens of this species in all the stages. The larvæ have been examined by Dr. H. G. Dyar and Mr. F. Knab, who report having discovered differences between them and the corresponding stage of the North American specimens of *pipiens*.

2. Thorax on the anterior half golden-yellow-scaled and with a pair of black-scaled spots, the posterior half black-scaled and with two stripes of yellow scales. (Middle America.) ..... *spissipes* Theob.
Thorax wholly golden-brown-scaled 3
3. Abdomen with bands of yellowish scales at the bases of the segments. (Middle America.) ..... *humilis* Theob.
Abdomen unbanded 4
4. Front angles of the segments of the abdomen yellowish-scaled ..... *atratus* Theob.
Front angles and whole of the abdominal segments black-scaled.
indecorabilis Theob., *melanurus* Coq.

Genus TINOLESTES Coquillett.

Feet unicolorous black; scales of the upper side of the body black and with light-colored ones in the front angles of some of the segments of the abdomen.
latisquama Coq.

Genus MICRAËDES Coquillett.

Proboscis and feet unicolorous black; scales of the abdomen purple-black and with light-colored ones in the front angles of some of the segments ..... *bisulcatus* Coq.

Genus ISOSTOMYIA Coquillett.

Proboscis, feet and abdomen wholly black-scaled ..... *perturbans* Will.
(*Aëdes nigricorpus* Theobald may also belong to this genus.)

Genus TÆNIORHYNCHUS Arribalzaga.

(Synonym: *Coquillettidia* Dyar.)

(*a*) Table of the Species.

1. Scales of the wings mixed black and light colored, those of the costa not forming distinct spots; scales of the feet black and with white ones at the bases of some of the joints 2
Scales of the wings wholly black. (Middle America.) 3
2. Abdomen black-scaled and with a white band at the base of each segment; hind tibiæ with a broad light-colored band before the apex ..... *perturbans* Walk.
Abdomen golden-yellow scaled and with several black scales on the first three segments; hind tibiæ devoid of a distinct light-colored band. (Middle America.) ..... *flaveolus* Coq.
3. Feet black-scaled and with white bands at the sutures of some of the joints, femora with a whitish spot or band at a point near three-fourths of their length 4
Feet wholly black except at the base of the first joint, femora devoid of a distinct white mark near three-fourths of their length; abdomen black-scaled and with a white band or median spot at the base of each of the last four segments and a white spot in the front angles of each segment ..... *palliatus* Coq.
4. Scales on the upper side of the abdomen black and with spots of white ones along the sides 5
Scales on the abdomen wholly black, on the thorax wholly brown.
arribalzagæ Theob.
5. White spots on the sides of the abdomen situated in the front angles of the segments; scales in the middle of the thorax yellow, those toward the sides chiefly black ..... *nigricans* Coq.
White spots on the sides of the abdomen situated near the middle of the segments; scales of the thorax brown and with several lines of light yellow ones.
fasciolatus Arrib.

(*b*) Unrecognized Species.

niger Giles, described from Antigua, West Indies.
richardi Ficalbi, a European species reported from Canada by Theobald.

(*c*) Species Wrongly Referred to this Genus.

antiquæ Giles and *confinis* Arribalzaga belong to *Grabhamia; fulrus* Wiedemann belongs to *Psorophora; sierrensis* Ludlow belongs to *Ochlerotatus.*

Genus MANSONIA Blanchard.

(Synonym: *Panoplites* Theobald.)

(*a*) Table of the Species.

Third joint of the feet black-scaled, the base narrowly white-scaled, scales of the tibiæ not forming distinct spots or bands.....*titillans* Walk.
Third joint of the hind feet wholly white-scaled, black and yellowish scales of the tibiæ collected into distinct bands and spots.....*fascipes* Coq.

(*b*) List of the Species and Synonymy.

fascipes Coq.

titillans Walk.
tæniorhynchus Arrib. (not of Wiedemann).

Genus AËDEOMYIA Theobald.

Proboscis with a white ring near the middle; joints of the feet white at their bases; scales of the wings brown, yellow, and white.....*squamipennis* Arrib.

Genus HÆMAGOGUS Williston.

(*a*) Table of the Species.

Scales of the abdomen bluish and with a row of silvery spots along each side, sometimes a small median spot of white scales on some of the segments...*cyaneus* Fab.

(*b*) List of the Species and Synonymy.

cyaneus Fab.
splendens Will.

(The following two species were originally described under *Hæmagogus.*)

Genus CACOMYIA, new genus.

Abdomen having white scales in the middle of the last two segments only.
albomaculatus Theob.
Abdomen having white scales in the middle of some of the other segments.
equinus Theob.

Genus GYMNOMETOPA Coquillett.

1. Upper side of the thorax brown-scaled and with six narrow lines of pale yellow scales extending the entire length of the thorax; last two joints of the hind feet black.
sexlineata Theob.
Upper side of the thorax not marked like this..... 2
2. Last two joints of the hind feet and all the tibiæ black..... 3
Last two joints of the hind feet chiefly white; a spot or band of white scales on the base of at least the first two joints on all of the feet; tibiæ with a silvery mark at a point about one-fourth of their length.....*mediovittata* Coq.
3. With a dot of silvery scales in the middle of the front end of the thorax; first two joints of the front feet white-scaled at their bases.....*albonotata* Coq.
Without such a dot; front feet wholly black-scaled.....*buscki* Coq.

Genus HOWARDINA Theobald.

Feet black-scaled, the base of the first three joints of the hind ones white-scaled; upper side of the thorax white-scaled along the sides, the median portion black-scaled and with four narrow lines of pale yellow scales, the two middle lines united into a single line posteriorly, the outer two lines situated on the posterior half of the thorax ..... *walkeri* Theob.

Genus PNEUMACULEX Dyar.

Thorax on the upper side velvety-brown-scaled and with six narrow lines of silvery scales ..... *signifer* Coq.

5. Subfamily DEINOCERITINÆ Mitchell.

Genus DEINOCERITES Theobald.

(Synonym: *Brachiomyia* Theobald.)

(*a*) Table of the Species.

Proboscis and feet unicolorous blackish; scales of the upper side of the body also blackish ..... *cancer* Theob.

(*b*) List of the Species and Synonymy.

cancer Theob.
magna Theob.

6. Subfamily URANOTÆNIINÆ Lahille.

Genus URANOTÆNIA Arribalzaga.

(*a*) Table of the Species.

1. Thorax with a median line of bluish scales; feet wholly black 2
   Thorax without a median line; hind feet white on at least the last two joints and broad apex of the third 3
2. Bluish median line of the thorax prolonged to the scutellum ..... *sapphirina* O. S.
   Bluish line obliterated before reaching the scutellum ..... *socialis* Theob.
3. Scutellum with blue scales; a patch of blue scales on the thorax a considerable distance in front of the scutellum; feet white at the sutures of many of the joints. (Middle America.) ..... *geometrica* Theob.
   Scutellum without blue scales; no patch of blue scales on the thorax in front of it; feet wholly black except the last two joints and apex of the third in the hind ones ..... *lowii* Theob.

(*b*) Unrecognized Species.

apicalis Theobald and *pulcherrima* Arribalzaga. Both of these have been reported from the West Indies.

7. Subfamily TRICHOPROSOPONINÆ Theobald.

(Synonyms: *Hyloconopinæ* Lutz, *Dendromyinæ* Lutz, *Sabettinæ* Blanchard.)

Table of the Genera.

1. Male palpi at least one-half as long as the proboscis; clypeus hairy. (Middle America.) ..... *Trichoprosopon.*
   Male palpi less than one-fourth as long as the proboscis; clypeus bare 2

2. Veins of the wings having the outstanding scales narrow and nearly linear; hind cross vein situated at least its own length before the small cross vein; legs never fringed with scales ..... *Wyeomyia.*
   Veins having many rather broad outstanding scales. (Middle America.) 3
3. Hind cross vein slightly before, opposite, or beyond the small cross vein, each foot bearing two claws 7
   Hind cross vein at least twice its own length before the small cross vein; legs never fringed with scales 4
4. With two claws on each hind foot; no scales on the posterior end of the thorax below the scutellum 5
   With only one claw on each hind foot in both sexes; posterior end of the thorax below the scutellum bearing several broad scales in addition to the bristles .. 6
5. Proboscis shorter than the body, thickened before its apex ..... *Dendromyia.*
   Proboscis longer than the body, not thickened toward its apex ..... *Phoniomyia.*
6. Male proboscis strongly curved in the outer half and with a cluster of scales at each end of the curved portion ..... *Limatus.*
7. Legs not fringed ..... *Sabethoides.*
   Legs fringed in places with outstanding scales in both sexes ..... *Sabethes.*

Genus TRICHOPROSOPON Theobald.

(Synonym: *Joblotia* Blanchard.)

Feet wholly black ..... *lunata* Theob.
Feet black, the last four joints of the middle feet and the last two of the hind ones white ..... *nivipes* Theob.

Genus WYEOMYIA Theobald.

Proboscis and upper side of the abdomen wholly black-scaled.
grayi Theob., *pertinans* Will., *smithii* Coq.

Genus DENDROMYIA Theobald.

Abdomen wholly black-scaled on the upper side; humeri black-scaled; first joint of the hind feet shorter than their tibiæ ..... *luteoventralis* Theob.

Genus PHONIOMYIA Theobald.

(*a*) Table of the Species.

Abdomen black-scaled, the front angles of the segments white-scaled.
longirostris Theob.

(*b*) List of the Species and Synonomy.

longirostris Theob.
trinidadensis Theob.

Genus LIMATUS Theobald.

(Synonym: *Simondella* Laveran.)

Thorax golden-yellow-scaled, a median, Y-shaped spot, with the prongs nearest the head, and a large spot above each wing violet-blue-scaled ..... *durhamii* Theob.

Genus SABETHOIDES Theobald.

Abdomen black-scaled, the under side and front angles of the segments whitish-scaled, the white-scaled front angles prolonged so as to form a crossband which is interrupted except sometimes on the last three segments ..... *confusus* Theob.
Abdomen black-scaled, the under side whitish-scaled, and encroaching on the sides of the dorsum, the border of the two colors strongly undulating ..... *undosus* Coq.

Genus SABETHES Desvoidy.

(*a*) TABLE OF THE SPECIES.

1. Front and hind legs not fringed 2
   Front and other legs fringed in places with outstanding scales; middle legs white-scaled before and beyond the fringed portion; the broad apices of the hind feet chiefly white-scaled ..... *longipes* Fab.
2. Legs black-scaled, the apical part of the fringe on the middle legs white. *nitidus* Theob.
   Legs wholly black-scaled ..... *locuples* Desv.

(*b*) LIST OF THE SPECIES AND SYNONOMY.

locuples Desv.
remipes Wied.

longipes Fab.

nitidus Theob.

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